Technical Evaluation Report

TO ASSIST WITH CODE COMPLIANCE

GCT Insulated Concrete Panel Design Properties & LRFD Factored Loads for Use as Floors, Walls & Roofs Within Building Systems

TER No. 1202-12.ls

Issue Date: April 28, 2012
Updated: May 18, 2016
Subject to Renewal: April 1, 2017

Gulf Concrete Technology

Gulf Concrete Technology
4739 West Oreck Road
Long Beach, MS 39560
866-936-6416
www.gctm2.com

DIVISION: 03 00 00 – CONCRETE
Section: 03 11 00 – Concrete Forming
Section: 03 11 19 – Insulating Concrete Forming
Section: 03 21 00 – Reinforcing Steel
Section: 03 31 16 – Lightweight Structural Concrete
Section: 03 37 00 – Specially Placed Concrete

DIVISION: 07 00 00 – THERMAL AND MOISTURE PROTECTION
Section: 07 21 00 – Thermal Insulation
Section: 07 25 00 – Water-Resistive Barriers/Weather Barriers
Section: 07 27 00 – Air Barriers

1. Products Evaluated:

1.1. GCT floor, wall and roof insulated concrete panels

1.1.1. PSP Series Panels

1.1.2. PSM Series Panels

1.1.3. PSM HP Series Panels

1.1.4. PSG Series Panels

1.2. For the most recent version of this report, visit drjengineering.org. For more detailed state professional engineering and code compliance legal requirements and references, visit drjengineering.org/statelaw. DrJ is fully compliant with all state professional engineering and code compliance laws.

2. Applicable Codes and Standards:[1]

2.1. *2009*, *2012* and *2015 International Building Code* (*IBC*)

2.2. *2009*, *2012* and *2015 International Residential Code* (*IRC*)

2.3. *2009*, *2012* and *2015 International Energy Conservation Code* (*IECC*)

2.4. *2010* and *2014 Florida Building Code* (*FBC*)

2.5. *ICC/NSSA – Standard for the Design and Construction of Storm Shelters* (*ICC 500*)

2.6. *ACI 318 – Building Code Requirements for Structural Concrete*

2.7. *ACI 506R – Guide to Shotcrete*

2.8. *ASCE 7 – Minimum Design Loads for Buildings and Other Structures*

2.9. *ASTM C387 – Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar*

2.10. *ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation*

2.11. *ASTM D1929 – Standard Test Method for Determining Ignition Temperature of Plastics*

2.12. *ASTM E72 – Standard Test Methods of Conducting Strength Tests of Panels for Building Construction*

2.13. *ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials*

2.14. *TAS 201 – Large and Small Missile Impact Test Standards*

2.15. *UL 752-05 – Standard for Bullet-Resisting Equipment*

3. Performance Evaluation:

3.1. GCT floor, wall and roof insulated concrete panels are composite assemblies used in bearing and non-bearing concrete wall applications and in reinforced concrete floor and roof assemblies.

3.1.1. The assemblies are used in both fire-rated and non-fire-rated construction.

3.2. GCT insulated concrete panels were tested in accordance with *ASTM E72* transverse and compressive loading techniques. Wall and roof/floor sections were tested to evaluate performance under the following conditions:

3.2.1. Structural performance under bending loading conditions for the purpose of determining the bending stiffness and strength for bending about each axis (strong and weak).

3.2.2. Structural performance under bending loading conditions for the purpose of determining the shear stiffness and strength for bending about each axis.

3.2.3. Structural performance under bending loading conditions for the purpose of determining the bearing reaction strength for bending about each axis.

3.2.4. Structural performance under concentric and eccentric compression loading conditions for the purpose of determining the compressive stiffness and strength about the strong axis.

3.2.5. Structural performance under concentric and eccentric compression loading conditions for the purpose of determining the compressive stiffness and strength about the strong axis with window and door openings.

3.2.6. Structural performance under concentric compression loading conditions for the purpose of determining the compressive bearing and shear capacity about the strong axis.

3.2.7. Structural performance under concentric and eccentric compression loading conditions for the purpose of determining compressive bearing and shear capacity about the strong axis with window and door openings.

[1] Unless otherwise noted, all references in this code compliant research report (TER) are from the 2012 version of the codes and the standards referenced therein, including, but not limited to, *ASCE 7*, *SDPWS* and *WFCM*. This product also complies with the 2000-2009 and 2015 versions of the *IBC* and *IRC* and the standards referenced therein. As required by law, where this research report is not approved, the building official shall respond in writing, stating the reasons this research report was not approved. For variations in state and local codes, if any, see Section 8.

3.3. GCT insulated concrete panels were tested in accordance with *UL 752-05* to determine their ability to meet or exceed ballistics protection level 3.

3.4. GCT insulated concrete panels were tested in accordance with *TAS 201-94* and *ICC 500* Section 804 to determine their resistance to wind-borne debris impact loads.

3.5. For GCT panel fire resistance, see TER No. 1201-04: *Fire-Resistance Ratings of Gulf Concrete Technologies Composite Concrete Assemblies – Required Mortar Thickness*.

3.6. GCT insulated concrete panels were evaluated to determine their ability to perform as an equivalent alternative to the foundation walls specified in *IRC* Section R404 and *IBC* Section 1807.

3.7. Any code compliance issues not specifically addressed in this section are outside the scope of this evaluation

4. Product Description and Materials:

4.1. GCT insulated concrete panels are prefabricated lightweight structural elements consisting of an expanded polystyrene (EPS) core sandwiched between two layers of galvanized steel welded wire mesh.

4.1.1. A steel wire connector is pierced completely through the EPS core and welded to each of the outer layer sheets of galvanized steel welded wire mesh.

4.1.2. Where needed, deformed steel reinforcement bars are used.

4.1.3. A high-strength mortar achieving 4,000 psi at 28 days is sprayed onto each side of the panels in the field at the jobsite to create monolithic wall, wall/slab and wall/roof concrete elements.

4.1.4. Application equipment designed specifically for the application of mortar mixes is highly recommended.

4.2. GCT wall panels designated PSP are used primarily for interior, partition walls. The PSP panels consist of a single layer of wire mesh on each side of an EPS core 3.15" in thickness. A typical section configuration is shown in Figure 1.

4.2.1. A minimum of 1.0" of mortar is required on each side of the panel.

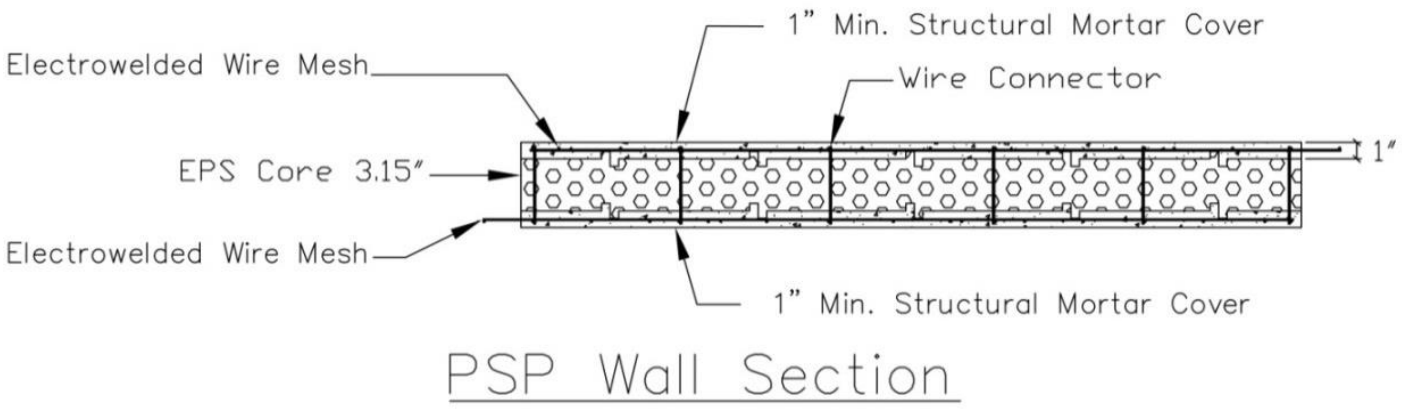


Figure 1: PSP Wall Section

4.3. GCT wall panels designated PSM consist of a single layer of wire mesh on each side of an EPS core varying from 1.6" up to 10" in thickness. A typical section configuration is shown in Figure 2.

4.3.1. A minimum of 0.75" of mortar cover is required over the outer face of the wire mesh on each side, resulting in an average of 1.4"-thick mortar cover on each side of the panel.

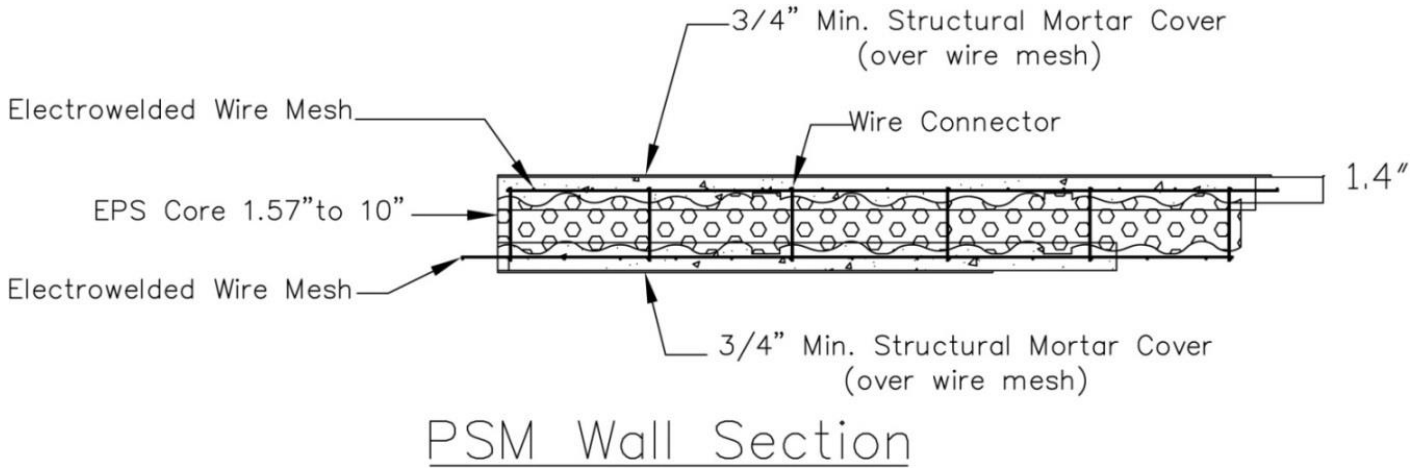


Figure 2: PSM Wall Section

4.4. GCT wall panels designated PSM HP consist of a double layer of wire mesh on each side of an EPS core varying from 1.6" up to 10" in thickness. A typical section configuration is shown in Figure 3.

4.4.1. A minimum of 0.75" of mortar cover is required over the outer face of the wire mesh on each side, resulting in an average of 2.0"-thick mortar cover on each side of the panel.

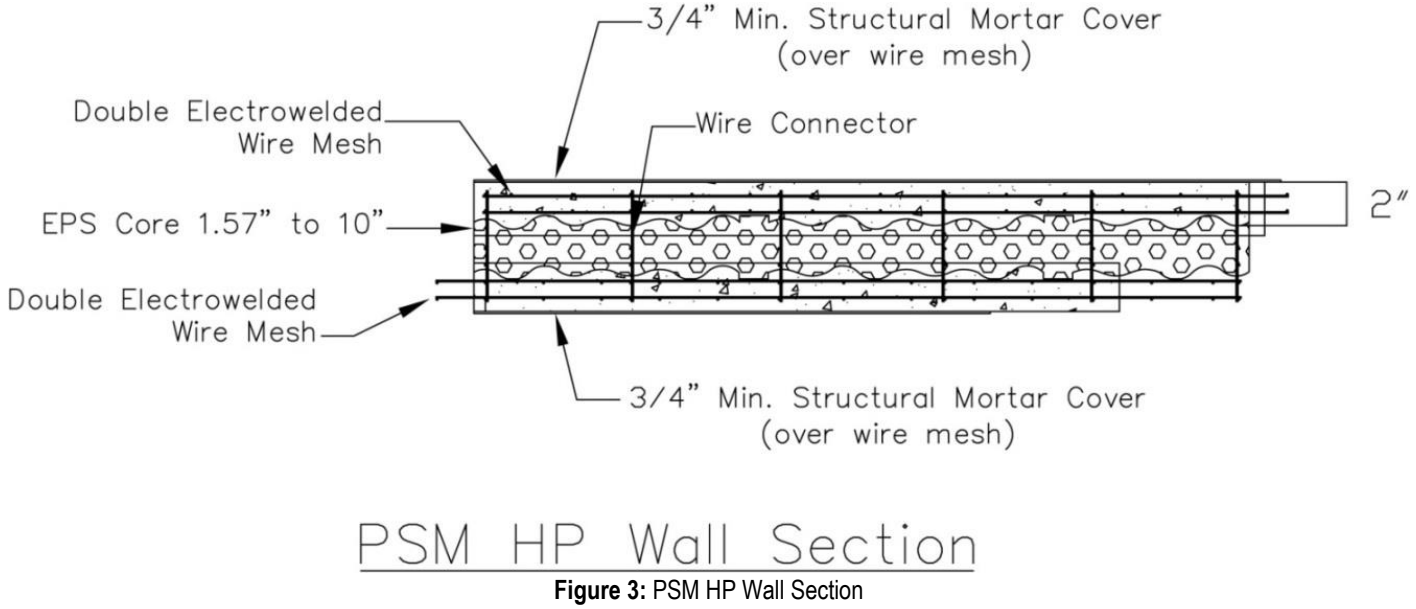


Figure 3: PSM HP Wall Section

4.5. GCT floor or roof panels designated PSM-Slab consist of EPS cores varying from 3" up to 10" in thickness. A typical section configuration is shown in Figure 4.

4.5.1. Working as floor slabs or a roof system, the upper side is poured with a concrete layer (3,500 psi) and will be 2.4" thick with at least 2" over the wire mesh.

4.5.2. The lower side of the section will require a minimum of 0.75" of mortar cover under the outer face of the wire mesh.

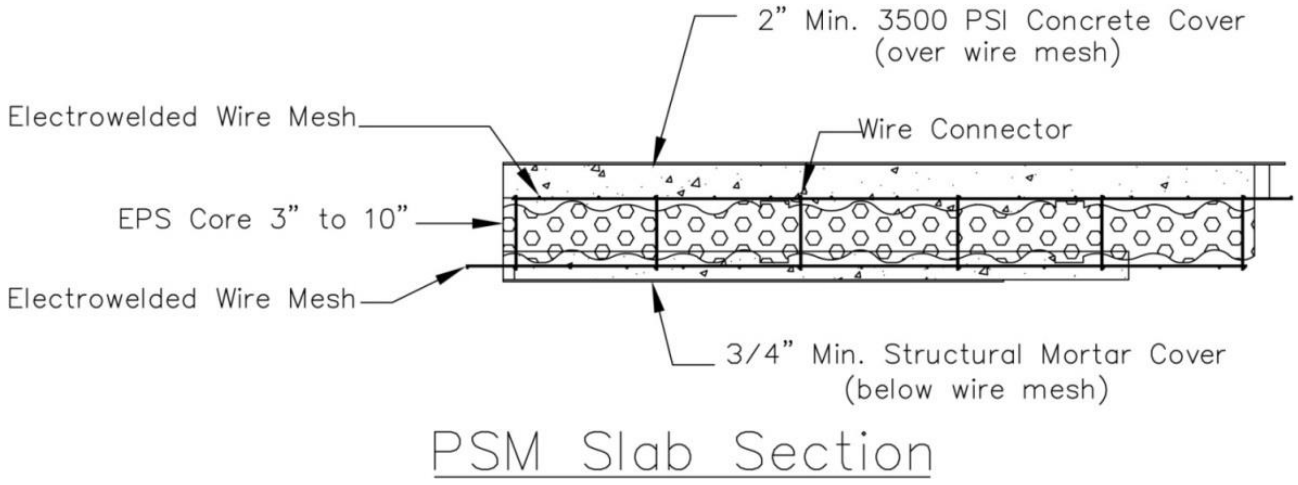


Figure 4: PSM-Slab Section

4.6. GCT floor slab or roof panels designated PSG2 consist of EPS cores with voids to form two (2) concrete joists for every 4' of width. A typical section configuration is shown in Figure 5.

4.6.1. The joist depth will vary from 4" to 10", according to the structural requirements.

4.6.2. The upper side is poured with a concrete layer (3,500 psi) and will be 2.4" thick with at least 2" over the wire mesh.

4.6.3. The lower side of the section will require a minimum of 0.75" of mortar cover under the outer face of the wire mesh for a total average depth of 1.4".

4.6.4. In addition, a minimum (2) #4 rebar is placed on the tension (lower) side of each concrete joist.

4.6.5. When required by the building design, rebar is placed in the top concrete layer.

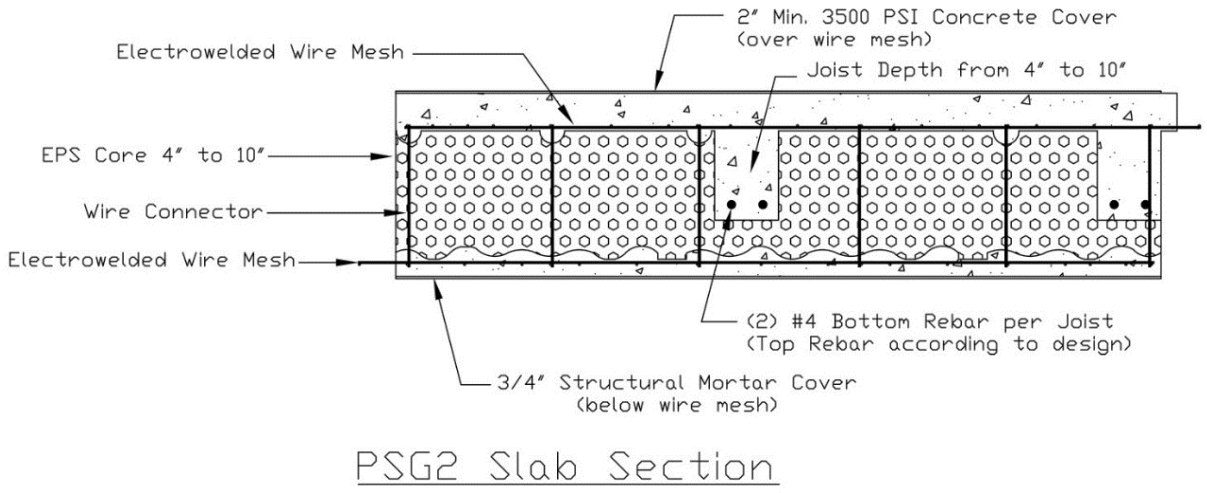


Figure 5: PSG2 Slab Section

4.7. GCT floor slab or roof panels designated PSG3 consist of EPS cores with voids to form three (3) concrete joists for every 4' of width. A typical section configuration is shown in Figure 6.

4.7.1. The joist depth will vary from 4" to 10", according to the requirements.

4.7.2. The upper side is poured with a concrete layer (3,500 psi) and will be 2.4" thick with at least 2" over the wire mesh.

4.7.3. The lower side of the section will require a minimum of 0.75" of mortar cover under the outer face of the wire mesh.

4.7.4. In addition, a minimum (2) #4 rebar is placed on the tension (lower) side of each concrete joist.

4.7.5. When required by the building design, rebar is placed in the top concrete layer.

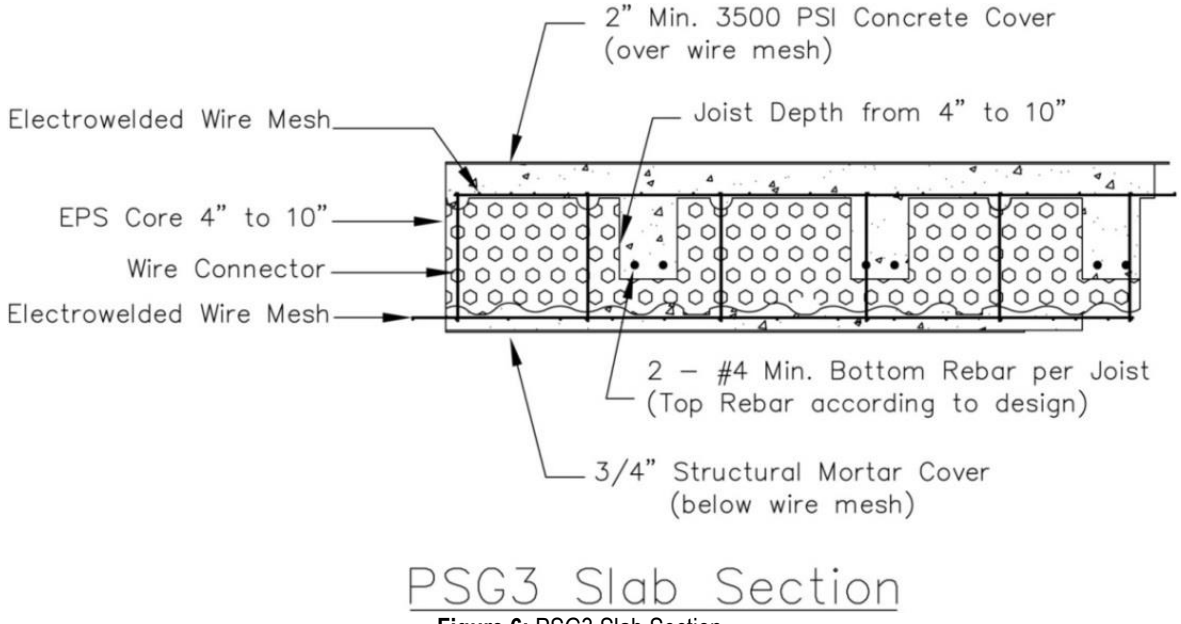


Figure 6: PSG3 Slab Section

4.8. GCT floor and roof panels designated PSG6 consist of EPS cores with voids to form six (6) concrete joists for every 4' of width. A typical section configuration is shown in Figure 7.

4.8.1. The joist depth will vary from 4" to 10", according to the requirements.

4.8.2. The upper side is poured with a concrete layer (3,500 psi) and will be 2.4" thick with at least 2" over the wire mesh.

4.8.3. The lower side of the section will require a minimum of 0.75" of mortar cover under the outer face of the wire mesh.

4.8.4. In addition, a minimum (2) #4 rebar is placed on the tension (lower) side of each concrete joist.

4.8.5. When required by the building design, rebar is placed in the top concrete layer.

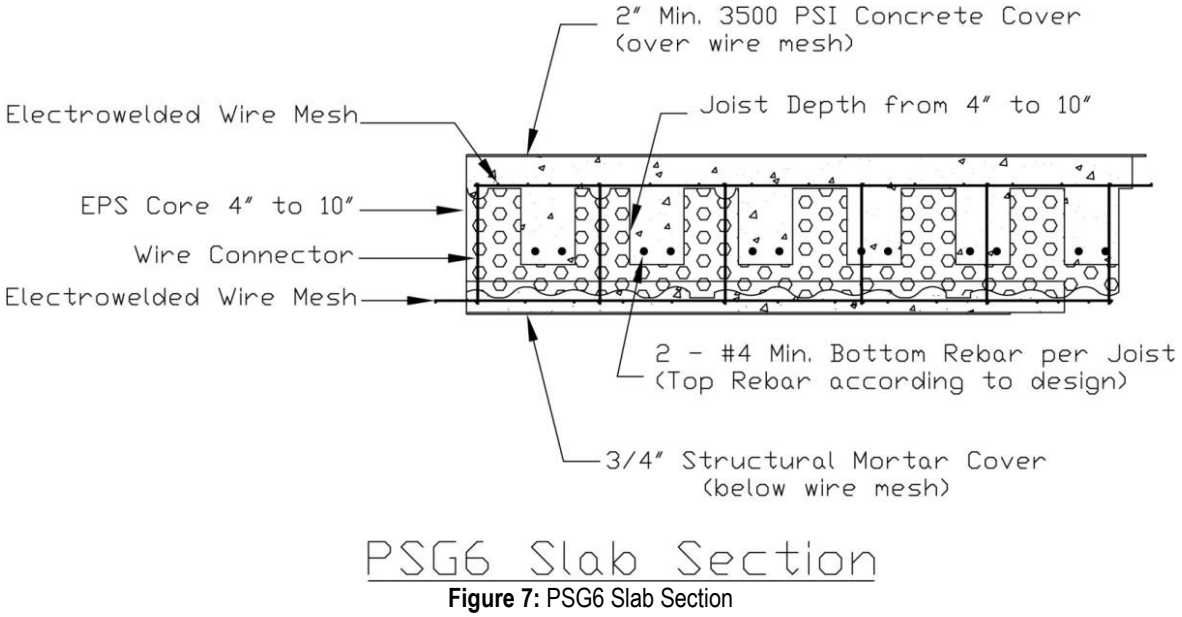


Figure 7: PSG6 Slab Section

4.9. GCT panels consisting of an EPS core and galvanized wire mesh are prefabricated and delivered to the jobsite where they are installed. The high-strength mortar and concrete are then applied on the jobsite.

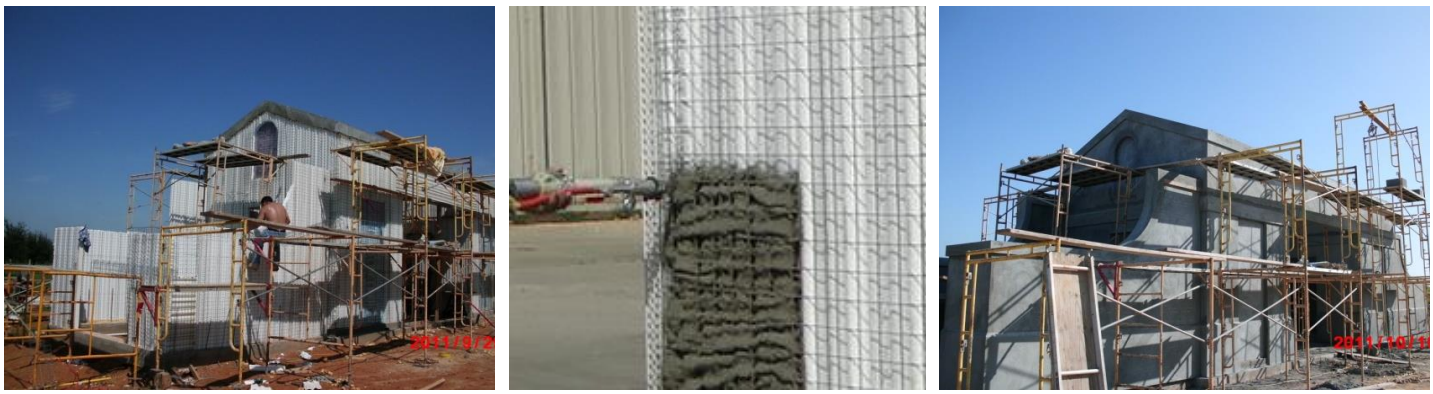


Photo 1: Photos of GCT Insulated Concrete Panels

4.10. GCT insulated concrete wall, floor and roof panels have the thicknesses and self-weights given in Table 1 and Table 2.

GCT Insulated Concrete Wall Panel Thickness & Self-Weight			
GCT Panel Type	**Wire-to-Wire Panel Thickness (in.)**	**Finish Panel Thickness (in.)**	**Self-Weight (psf)**
PSP75	3.50	5.10	26
PSM60	3.20	4.90	35
PSM80	4.00	5.65	35
PSM100	4.70	6.40	35
PSM120	5.50	7.20	35
PSM140	6.25	7.95	35
PSM160	7.00	8.70	35
PSM190	8.40	10.10	35
PSM240	10.43	12.13	35
PSM HP60	4.70	6.20	48
PSM HP80	5.50	7.00	49
PSM HP100	6.25	7.75	49
PSM HP120	7.00	8.50	49
PSM HP140	7.75	9.25	49
PSM HP160	8.50	10.00	49

Table 1: GCT Insulated Concrete Wall Panel Thickness & Self-Weight

GCT Insulated Concrete Floor & Roof Panel Thickness & Self-Weight			
GCT Panel Type	**Wire-to-Wire Panel Thickness (in.)**	**Finish Panel Thickness (in.)**	**Self-Weight (psf)**
PSM80-Slab	4.00	6.90	51
PSM100-Slab	4.70	7.65	51
PSM120-Slab	5.50	8.45	51
PSM140-Slab	6.25	9.20	51
PSM160-Slab	7.00	9.95	51
PSM190-Slab	8.40	11.35	51
PSM240-Slab	10.43	13.50	51
PSG2-100	6.00	8.75	51
PSG2-140	7.60	10.35	55
PSG2-160	8.35	11.10	57
PSG2-200	9.95	12.70	60
PSG2-240	11.50	14.25	64
PSG3-100	6.00	8.75	56
PSG3-140	7.60	10.35	61
PSG3-160	8.35	11.10	63
PSG3-200	9.95	12.70	68
PSG3-240	11.50	14.25	74
PSG6-100	6.00	8.75	69
PSG6-140	7.60	10.35	79
PSG6-160	8.35	11.10	84
PSG6-200	9.95	12.70	93
PSG6-240	11.50	14.25	106
PSG6-100R	11.50	14.25	69
PSG6-140R	11.50	14.25	79
PSG6-160R	11.50	14.25	84
PSG6-200R	11.50	14.25	93

Table 2: GCT Insulated Concrete Floor & Roof Panel Thickness & Self-Weight

4.11. Material

4.11.1. EPS Core

4.11.1.1. The EPS foam core is made up of Type I EPS foam boards conforming to *ASTM C578*.

4.11.1.2. The EPS core is molded into proprietary shapes, which vary depending on the intended application (i.e., wall, floor or roof application).

4.11.1.3. The EPS core thickness varies depending on the application as described in Section 4.1 to 4.8.

4.11.1.4. The EPS core has the following characteristics.

4.11.1.4.1. Minimum Density: 0.9 lbs./cf

4.11.1.4.2. Flame Spread Index[2]: 25 or less

4.11.1.4.3. Smoke Developed Index[3]: 450 or less

4.11.2. Steel Welded Wire Mesh

4.11.2.1. The galvanized steel welded wire mesh is made from steel with a minimum yield of 85 ksi and a minimum fracture of 95 ksi, and it also complies with *ACI 318-14* Section 20.2.1.7 and *IBC* Section 1903.

4.11.2.2. Longitudinal or principal direction wires are 3.0 mm (11 gauge) in thickness and have an equivalent spacing of 3.0" o.c.

4.11.2.3. Transverse or secondary direction wires are 2.5 mm (12.5 gauge) in thickness and have a uniform spacing of 5.1" o.c. for PSP panels and 2.6" o.c. for all other panel types.

4.11.2.4. The front and back wire mesh layers are tied together along the longitudinal direction in six (6) rows with 3.0 mm (11 gauge) wire.

4.11.3. Other Reinforcement

4.11.3.1. Where required, deformed steel reinforcement bars are used, which have a minimum yield stress of 60 ksi and comply with *ACI 318-14* Section 20.2.1.3 and *IBC* Section 1903.

4.11.4. Mortar Application

4.11.4.1. Carmelo Structural Mortar Mix is recommended because it has a compressive strength of 4,000 psi for the application on the GCT insulated concrete panels.

4.11.4.1.1. Other structural mortar mixes may be used if they provide strength and stiffness that are at least equivalent to the Carmelo Structural Mortar Mix as described in Section 4.11.4.

4.11.4.2. Carmelo Structural Mortar Mix is a single component Portland cement-based plaster containing additives to enhance its bonding strength.

4.11.4.3. The mortar contains micro-spheres with pozzolanic action to make it less permeable, in addition to making it easy to place and finish.

4.11.4.4. Low-pressure mortar application equipment is highly recommended for speed, quality and consistency.

4.11.4.4.1. The mortar used must have the following characteristics.

4.11.4.4.1.1. Comply with *ASTM C387.*

4.11.4.4.1.2. Minimum compressive strength of 4,000 psi at 28 days according to *ASTM C387*

4.11.4.4.1.3. Maximum aggregate size: $^{3}/_{16}$"

4.11.4.4.1.4. Aggregate must conform to *ACI 506R-05* Table 1.1

[2] When tested in accordance with *ASTM E84* in a 4" thickness and maximum 1.0 pcf density.
[3] When tested in accordance with *ASTM E84* in a 4" thickness and maximum 1.0 pcf density.

4.11.5. Concrete

4.11.5.1. The placed concrete must be a normal weight complying with *IBC* Chapter 19 and have the following characteristics.

4.11.5.1.1. Compressive strength: 3,500 psi minimum at 28 days

4.11.5.1.2. Slump: minimum 2"

4.11.5.1.3. Aggregate size: $^1/_2$" maximum

4.12. Material Properties

4.12.1. GCT insulated concrete wall and floor panels have the material properties given in Table 3 and Table 4.

GCT Insulated Concrete Wall Panel Material Properties							
GCT Panel Type	**Gross Section Bending Stiffness, EI [lb.-in.²/ft. of Panel Width]**	**Cracked Section Bending Stiffness, EI [lb.-in.²/ft. of Panel Width]**	**Cracking Moment, M_{cr} [ft.-lbs./ft. of Panel Width]**	**Nominal Flexural Strength, M_n [ft.-lb./ft. of Panel Width]**	**Nominal Shear Strength, V_n (lb./Q) [lbs./ft. of Panel Width]**	**Axial Stiffness, EA [lbs./ft. of Panel Width]**	**Nominal Compressive Strength, P_n [lbs./ft. of Panel Width]**
PSP75	72,000,000	5,900,000	500	905	2,065	48,000,000	19,075
PSM60	68,000,000	5,600,000	500	1,520	4,129	65,280,000	38,150
PSM80	97,000,000	8,000,000	600	1,810	4,129	65,280,000	38,150
PSM100	119,000,000	9,900,000	700	2,000	4,129	65,280,000	38,150
PSM120	154,000,000	12,700,000	800	2,270	4,129	65,280,000	38,150
PSM140	212,000,000	17,500,000	1,000	2,650	4,129	65,280,000	38,150
PSM160	261,000,000	21,500,000	1,300	2,930	4,129	65,280,000	38,150
PSM190	337,000,000	27,900,000	1,400	3,330	4,129	65,280,000	38,150
PSM240	503,000,000	41,500,000	1,700	4,040	4,129	65,280,001	36,700
PSM HP60	183,000,000	15,100,000	1,000	3,590	5,742	90,720,000	50,900
PSM HP80	247,000,000	20,400,000	1,200	4,150	5,742	90,720,000	50,900
PSM HP100	298,000,000	24,600,000	1,300	4,540	5,742	90,720,000	50,900
PSM HP120	374,000,000	30,900,000	1,400	5,080	5,742	90,720,000	50,900
PSM HP140	499,000,000	41,200,000	1,900	5,840	5,742	90,720,000	50,900
PSM HP160	602,000,000	49,700,000	2,200	6,400	5,742	90,720,000	50,900

Table 3: Material Properties for GCT Insulated Concrete Wall Panels

GCT Insulated Concrete Floor & Roof Panel Material Properties					
GCT Panel Type	Gross Section Bending Stiffness, EI [lb.-in.²/ft. of Panel Width]	Cracked Section Bending Stiffness, EI [lb.-in.²/ft. of Panel Width]	Cracking Moment, M_{cr} [ft.-lbs./ft. of Panel Width]	Nominal Flexural Strength, M_n [ft.-lb./ft. of Panel Width]	Nominal Shear Strength, V_n (lb./Q) [lbs./ft. of Panel Width]
PSM80-Slab	274,000,000	16,000,000	1,250	2,255	5,635
PSM100-Slab	325,000,000	19,000,000	1,400	2,450	5,635
PSM120-Slab	402,000,000	24,000,000	1,600	2,715	5,635
PSM140-Slab	525,000,000	32,000,000	1,900	3,095	5,635
PSM160-Slab	627,000,000	38,000,000	2,300	3,380	5,635
PSM190-Slab	785,000,000	48,000,000	2,500	3,775	5,635
PSM240-Slab	1,142,000,000	69,000,000	2,500	4,535	5,635
PSG2-100	625,000,000	124,000,000	2,400	7,730	5,725
PSG2-140	1,023,000,000	204,000,000	3,400	9,840	6,095
PSG2-160	1,263,000,000	252,000,000	3,800	10,895	6,275
PSG2-200	1,822,000,000	364,000,000	4,600	13,000	6,645
PSG2-240	2,672,000,000	534,000,000	6,500	15,640	7,100
PSG3-100	772,000,000	154,000,000	2,700	10,035	6,220
PSG3-140	1,293,000,000	258,000,000	4,000	12,920	6,770
PSG3-160	1,608,000,000	321,000,000	4,400	14,360	7,045
PSG3-200	2,348,000,000	469,000,000	6,000	17,240	7,595
PSG3-240	3,482,000,000	696,000,000	8,000	20,845	8,285
PSG6-100	1,153,000,000	230,000,000	3,500	16,470	7,700
PSG6-140	2,002,000,000	400,000,000	5,500	21,670	8,800
PSG6-160	2,522,000,000	504,000,000	6,200	24,270	9,350
PSG6-200	3,756,000,000	750,000,000	8,000	29,475	10,450
PSG6-240	5,669,000,000	1,133,000,000	11,000	35,975	11,825
PSG6-100R	1,601,000,000	320,000,000	4,500	18,340	7,415
PSG6-140R	2,342,000,000	468,000,000	5,500	23,005	8,525
PSG6-160R	2,801,000,000	559,000,000	6,500	25,335	9,065
PSG6-200R	3,903,000,000	780,000,000	7,500	30,005	10,175

Table 4: Material Properties for GCT Insulated Concrete Floor & Roof Panels

4.12.2. An effective bending stiffness for calculating deflections of GCT insulated concrete panels can be determined from the following equation:

$$EI_e = \left(\frac{M_{cr}}{M_a}\right)^x EI_g + \left[1 - \left(\frac{M_{cr}}{M_a}\right)^x\right] EI_{cr} \leq EI_g$$

where:

M_{cr} = Cracking moment for GCT insulated concrete panels given in Table 3 and Table 4

M_a = Maximum moment in member due to service loads at stage deflection is computed

EI_g = Bending stiffness of gross panel section given in Table 3 and Table 4

EI_{cr} = Bending stiffness of cracked panel section given in Table 3 and Table 4

x = 3 for PSP, PSM, PSM HP, and PSM-Slab panels

x = 2 for PSG2, PSG3, and PSG6 panels

4.12.3. Additional long-term deflection resulting from creep and shrinkage can be determined by multiplying the immediate deflection due to sustained loads by the factor λ_Δ: (see *ACI 318-14* Section 24.2.4.1.1)

$$\lambda_\Delta = \frac{\xi}{1 + 50\rho'}$$

where:

ξ = Time dependent factor for sustained loads = 2.0 (for 5 years or more)

ρ' = Reinforcement ratio for the compression steel

4.12.4. GCT insulated concrete panels may be cambered to reduce the immediate deflection due to dead load and the long-term deflection due to sustained loads.

5. Applications:

5.1. GCT insulated concrete panels have the factored axial load capacity, using the controlling design condition of compressive strength or buckling, as shown in Table 5.

GCT Panel Type	Self-Weight (psf)	Factored Axial Load Capacity (plf) for Wall Height (ft.)[1]						
		Wall Heights (ft.)						
		8'	10'	12'	14'	16'	18'	20'
PSP75	26	12,400	9,290	6,450	4,740	3,630	2,865	2,320
PSM60	35	20,055	12,835	8,910	6,545	5,010	3,960	3,205
PSM80	35	24,805	18,585	12,905	9,480	7,260	5,735	4,645
PSM100	35	24,805	23,265	16,155	11,870	9,085	7,180	5,815
PSM120	35	24,805	24,805	21,160	15,545	11,905	9,405	7,615
PSM140	35	24,805	24,805	24,805	21,650	16,575	13,095	10,605
PSM160	35	24,805	24,805	24,805	24,805	20,540	16,225	13,145
PSM190	35	24,805	24,805	24,805	24,805	24,805	21,185	17,160
PSM240	35	24,805	24,805	24,805	24,805	24,805	24,805	24,805
PHP60	49	36,660	36,660	30,830	22,650	17,340	13,700	11,095
PHP80	49	36,660	36,660	36,660	31,250	23,925	18,905	15,310
PHP100	49	36,660	36,660	36,660	36,660	29,195	23,070	18,685
PHP120	49	36,660	36,660	36,660	36,660	36,660	29,415	23,825
PHP140	49	36,660	36,660	36,660	36,660	36,660	36,660	32,235
PHP160	49	36,660	36,660	36,660	36,660	36,660	36,660	36,660
Values limited by buckling.								
Values limited by compressive strength.								
1. Capacities in this table are for pure compression load only. Bending moments due to eccentric loads are not considered. See the interaction diagrams for combined flexure and axial loads.								

Table 5: Factored Axial Load Capacity for Wall Heights

5.2. GCT insulated concrete wall panels have the factored uniform transverse load (i.e., wind, soil, pressure, etc.) capacities listed in Table 6. The load capacities shown are limited by the controlling design condition of shear strength, bearing strength, bending strength or deflection at L/240 for walls with brittle finishes.

GCT Panel Type	Self-Weight (psf)	Factored Uniform Load Capacity (psf) Using Wall Deflection Limit of L/240[1, 2]										
		Wall Height (ft.)										
		6'	8'	10'	12'	14'	16'	18'	20'	24'	28'	32'
PSP75	26	180	90	55	35	25	20	15	10	5	5	–
PSM60	35	275	140	85	55	40	30	20	15	10	5	5
PSM80	35	360	185	110	75	50	45	35	25	15	10	5
PSM100	35	400	220	130	85	60	45	35	25	15	10	5
PSM120	35	455	255	160	105	75	55	40	30	20	15	10
PSM140	35	530	295	190	130	95	70	50	40	25	20	10
PSM160	35	585	330	210	145	105	80	60	50	30	20	15
PSM190	35	665	375	240	165	120	90	70	60	40	25	20
PSM240	35	810	455	290	200	150	115	90	70	50	35	25
PSM HP60	49	605	310	180	120	85	60	45	35	25	15	10
PSM HP80	49	775	390	230	150	105	75	60	45	30	20	15
PSM HP100	49	900	455	265	175	120	90	70	55	35	25	15
PSM HP120	49	1,015	545	320	210	145	105	80	65	40	30	20
PSM HP140	49	1,165	655	400	260	180	135	100	80	50	35	25
PSM HP160	49	1,280	720	460	305	210	155	115	90	60	40	30
Values limited by flexural capacity.												
Valued limited by deflection limit.												

1. The deflection limit is L/240 for walls with brittle finishes per *IBC* Table 1604.3. Other deflection limits can be provided upon request.
2. Assumes that the panel is oriented with the strong axis in the vertical direction.

Table 6: Factored Uniform Load Capacity for GCT Insulated Concrete Wall Panels

5.3. GCT insulated concrete floor and roof panels have the factored uniform load (i.e., bedroom, office, snow, load, etc.) capacities listed in Table 7. The load capacities shown are limited by the controlling design condition of shear strength, bearing strength, bending strength or deflection (minimum code requirement for the floor) at L/360 for live load (LL) and L/240 for total load (TL).

GCT Panel Type	Self-Weight (psf)	Factored Uniform Load Capacity (psf) Using 15 psf of DL & Floor Deflection Limits of L/360 for LL & L/240 for TL[1,2]										
		Span Length (ft.)										
		6'	8'	10'	12'	14'	16'	18'	20'	24'	28'	32'
PSM80-Slab	51	450	250	160	110	80	–	–	–	–	–	–
PSM100-Slab	51	490	275	175	120	90	–	–	–	–	–	–
PSM120-Slab	51	540	305	195	135	100	75	–	–	–	–	–
PSM140-Slab	51	620	345	220	155	110	85	65	–	–	–	–
PSM160-Slab	51	675	380	240	165	120	95	75	–	–	–	–
PSM190-Slab	51	755	425	270	185	135	105	80	65	–	–	–
PSM240-Slab	51	905	510	325	225	165	125	100	80	–	–	–
PSG2-100	51	1,430	870	555	385	280	195	135	100	–	–	–
PSG2-140	55	1,520	1,105	705	490	360	275	215	160	90	–	–
PSG2-160	57	1,570	1,175	780	545	400	305	240	195	115	–	–
PSG2-200	60	1,660	1,245	935	650	475	365	285	230	160	100	–
PSG2-240	64	1,775	1,330	1065	780	575	440	345	280	195	140	100
PSG3-100	56	1,555	1,125	720	500	340	235	165	120	–	–	–
PSG3-140	61	1,690	1,270	930	645	475	360	270	200	115	–	–
PSG3-160	63	1,760	1,320	1,030	715	525	400	315	245	145	–	–
PSG3-200	68	1,895	1,420	1,140	860	630	485	380	310	205	130	–
PSG3-240	74	2,070	1,550	1,240	1,035	765	585	460	375	260	190	125
PSG6-100	69	1,925	1,440	1,075	710	485	335	240	175	–	–	–
PSG6-140	79	2,200	1,650	1,320	1,080	775	555	400	295	175	–	–
PSG6-160	84	2,335	1,750	1,400	1,165	890	680	495	365	215	135	–
PSG6-200	93	2,610	1,960	1,565	1,305	1,080	825	655	530	315	200	130
PSG6-240	106	2,955	2,215	1,770	1,475	1,265	1,010	795	645	450	295	195
PSG6-100R	69	1,855	1,390	1,110	915	650	455	330	240	140	--	--
PSG6-140R	79	2,130	1,595	1,275	1,065	845	645	465	345	200	125	--
PSG6-160R	84	2,265	1,700	1,360	1,130	930	710	545	405	240	150	--
PSG6-200R	93	2,540	1,905	1,525	1,270	1,090	840	665	540	325	205	135

Values limited by flexural capacity.

Valued limited by deflection limit.

Valued limited by shear capacity.

1. The deflection limit is based on the controlling case of L/240 for the dead load plus live load combination and L/360 for the live load combination per *IBC* Table 1604.3. Other deflection limits can be provided upon request.
2. The load factor for converting service loads computed from the deflection limit to the factored loads in the table is based on a dead load equal to the panel self-weight plus 15 psf.

Table 7: Factored Uniform Load Capacity for GCT Insulated Concrete Floor Panels

5.4. GCT insulated concrete roof panels have the factored uniform load (i.e., snow load) capacities listed in Table 8. The load capacities shown are limited by the controlling design condition of shear strength, bearing strength, bending strength or deflection (minimum code requirement for the roof) at L/240 for LL and L/180 for TL.

GCT Panel Type	Self-Weight (psf)	Factored Uniform Load Capacity (psf) Using 15 psf of DL & Roof Deflection Limits of L/240 for LL & L/180 for TL[1,2]										
		Span Length (ft.)										
		6'	8'	10'	12'	14'	16'	18'	20'	24'	28'	32'
PSM80-Slab	51	450	250	160	110	80	–	–	–	–	–	–
PSM100-Slab	51	490	275	175	120	90	65	–	–	–	–	–
PSM120-Slab	51	540	305	195	135	100	75	–	–	–	–	–
PSM140-Slab	51	620	345	220	155	110	85	65	–	–	–	–
PSM160-Slab	51	675	380	240	165	120	95	75	60	–	–	–
PSM190-Slab	51	755	425	270	185	135	105	80	65	–	–	–
PSM240-Slab	51	905	510	325	225	165	125	100	80	–	–	–
PSG2-100	51	1,430	870	555	385	280	215	165	120	–	–	–
PSG2-140	55	1,520	1,105	705	490	360	275	215	175	110	–	–
PSG2-160	57	1,570	1,175	780	545	400	305	240	195	135	–	–
PSG2-200	60	1,660	1,245	935	650	475	365	285	230	160	115	–
PSG2-240	64	1,775	1,330	1,065	780	575	440	345	280	195	140	110
PSG3-100	56	1,555	1,125	720	500	365	280	200	145	–	–	–
PSG3-140	61	1,690	1,270	930	645	475	360	285	230	140	–	–
PSG3-160	63	1,760	1,320	1,030	715	525	400	315	255	170	105	–
PSG3-200	68	1,895	1,420	1,140	860	630	485	380	310	215	155	100
PSG3-240	74	2,070	1,550	1,240	1,035	765	585	460	375	260	190	145
PSG6-100	69	1,925	1,440	1,155	820	590	405	290	210	120	–	–
PSG6-140	79	2,200	1,650	1,320	1,080	795	610	480	355	210	130	–
PSG6-160	84	2,335	1,750	1,400	1,165	890	680	535	435	260	160	–
PSG6-200	93	2,610	1,960	1,565	1,305	1,080	825	655	530	365	240	160
PSG6-240	106	2,955	2,215	1,770	1,475	1,265	1,010	795	645	450	330	240
PSG6-100R	69	1,855	1,390	1,110	915	670	515	395	290	170	105	–
PSG6-140R	79	2,130	1,595	1,275	1,065	845	645	510	410	245	150	–
PSG6-160R	84	2,265	1,700	1,360	1,130	930	710	560	455	290	180	115
PSG6-200R	93	2,540	1,905	1,525	1,270	1,090	840	665	540	375	250	165

Values limited by flexural capacity.

Valued limited by deflection limit.

Valued limited by shear capacity.

1. The deflection limit is based on the controlling case of L/240 for the dead load plus live load combination and L/360 for the live load combination per *IBC* Table 1604.3. Other deflection limits can be provided upon request.
2. The load factor for converting service loads computed from the deflection limit to the factored loads in the table is based on a dead load equal to the panel self-weight plus 15 psf.

Table 8: Factored Uniform Load Capacity for GCT Insulated Concrete Roof Panels

5.5. Window and Door Headers

5.5.1. GCT panel headers have the factored uniform load capacities listed in Table 9a, and beams have the factored uniform load capacities listed in Table 9b. Beam details are shown in Detail 1-6.

Header Factored Uniform Load Capacity (plf)[1, 2, 3]												
GCT Panel Type	Header Depth (in.)	Header Span (ft.)										
		2'	2.5'	3'	3.5'	4'	4.5'	5'	5.5'	6'	6.5'	7'
PSM	12"	8,960	8,920	6,190	4,550	3,480	2,750	2,230	1,840	1,540	1,310	1,130
	18"	13,450	13,450	11,410	8,380	6,420	5,070	4,100	3,390	2,850	2,430	2,090
	24"	17,930	17,930	17,850	13,110	10,040	7,930	6,420	5,310	4,460	3,800	3,270
	30"	22,420	22,420	22,420	18,730	14,340	11,330	9,180	7,580	6,370	5,430	4,680
	36"	26,900	26,900	26,900	25,230	19,320	15,260	12,360	10,220	8,580	7,310	6,300
PSM HP	12"	12,460	12,460	9,570	7,030	5,380	4,250	3,440	2,840	2,390	2,030	1,750
	18"	18,690	18,690	18,240	13,400	10,260	8,100	6,560	5,420	4,560	3,880	3,350
	24"	24,920	24,920	24,920	21,550	16,500	13,040	10,560	8,720	7,330	6,250	5,380
	30"	31,150	31,150	31,150	31,150	24,100	19,040	15,420	12,740	10,710	9,120	7,860
	36"	37,380	37,380	37,380	37,380	33,050	26,110	21,150	17,480	14,680	12,510	10,790
Values limited by shear at the support.												
Values limited by flexural strength.												
1. In all cases, the minimum header depth shall be at least 12". 2. Assumes that all applied loads are live loads. 3. The primary (strong) axis of the panels may be installed in either the vertical or horizontal orientation where the length of the header is 4 feet or less. For headers greater than 4 feet in length, panels shall be oriented with the primary axis in the horizontal orientation.												

Table 9a: Vertical Load Capacity of GCT Panel Headers

Uniform Factored Load (PLF)										
Beam Detail No.	Bottom Reinforcement	Top Reinforcement	Beam Depth (in)	8	10	12	14	16	18	20
1)	PSM Panel without additional reinforcement		12	441	282	196	144	110	87	71
			16	801	513	356	262	200	158	128
			20	1311	839	582	428	328	259	210
			24	1940	1242	862	634	485	383	310
			30	3113	1993	1384	1017	778	615	498
			36	4544	2908	2020	1484	1136	898	727
			48	6693	5309	3687	2709	2074	1639	1327
2)	PSM Panel with two layers of wire mesh (or PSM HP Panel)		12	793	507	352	259	198	157	127
			16	1506	964	669	492	376	297	241
			20	2449	1567	1088	800	612	484	392
			24	3220	2316	1609	1182	905	715	579
			30	4088	3270	2601	1911	1463	1156	936
			36	4956	3965	3304	2773	2123	1677	1359
			48	6693	5354	4462	3825	3346	2975	2463
3)	(2) #4	N/A	12	1483	1187	792	499	334	235	171
			16	2062	1650	1375	1038	745	523	381
			20	2641	2113	1761	1416	1084	856	694
			24	3220	2576	2147	1819	1392	1100	891
			30	4088	3270	2725	2336	1900	1502	1216

Uniform Factored Load (PLF)										
Beam Detail No.	Bottom Reinforcement	Top Reinforcement	Beam Depth (in)	8	10	12	14	16	18	20
			36	4956	3965	3304	2832	2454	1939	1571
			48	6693	5354	4462	3825	3346	2911	2358
4)	(3) #4	(2) #4	12	1483	1187	989	720	482	339	247
		N/A	16	2062	1650	1375	1178	940	660	481
			20	2641	2113	1761	1509	1320	1151	879
			24	3220	2576	2147	1840	1610	1431	1205
			30	4088	3270	2725	2336	2044	1817	1620
			36	4956	3965	3304	2832	2478	2203	1983
			48	6693	5354	4462	3825	3346	2975	2677
5)	(4) #4	(2) #5	12	1375	1100	917	719	481	338	246
		(2) #4	16	1954	1563	1302	1116	977	770	561
		N/A	20	2532	2026	1688	1447	1266	1126	939
			24	3111	2489	2074	1778	1556	1383	1245
			30	3980	3184	2653	2274	1990	1769	1592
			36	4848	3878	3232	2770	2424	2155	1939
			48	6584	5268	4390	3763	3292	2926	2634
6)	(5) #4	(2) #6	12	1375	1100	917	786	567	398	290
		(2) #4	16	1954	1563	1302	1116	977	833	607
		(2) #4	20	2532	2026	1688	1447	1266	1126	1013
		N/A	24	3111	2489	2074	1778	1556	1383	1245
			30	3980	3184	2653	2274	1990	1769	1592
			36	4848	3878	3232	2770	2424	2155	1939
			48	6584	5268	4390	3763	3292	2926	2634

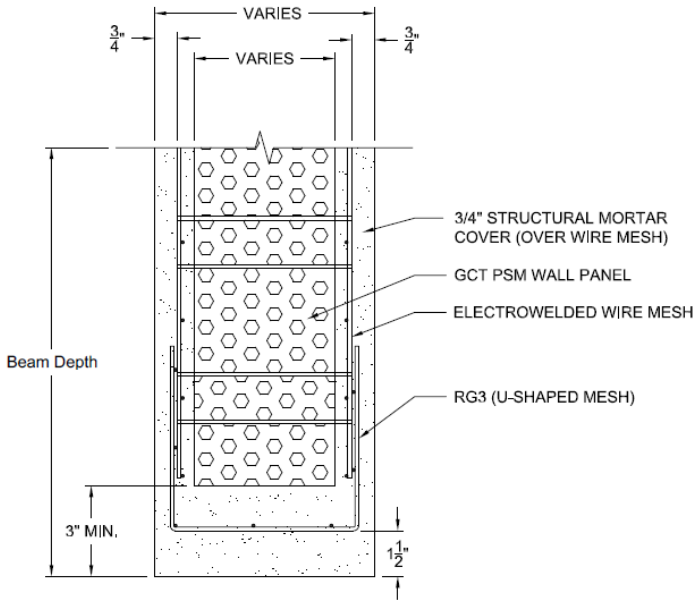
Values limited by shear at the support.

Values limited by flexural strength.

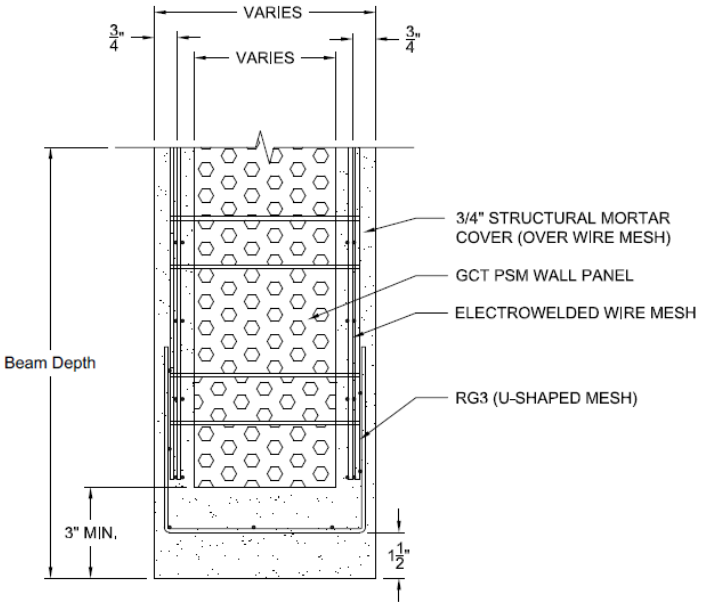
Values limited by deflection.

1. Top and Bottom reinforcement shall have 1.5" of concrete cover from the face of the bars to the exterior of the panel and 0.5" of cover on the interior of the panel.
2. Deflection limit is L/360 for total load. The live load is assumed to be 50% of the total load.
3. Beams with rebar are assumed to be simply supported. Beams without rebar are assumed to have a fixed connection.
4. Design assumes that the panel is oriented with the strong axis in the horizontal direction.
5. The minimum beam depth shall be at least 12" and shall have at least two longitudinal wires.

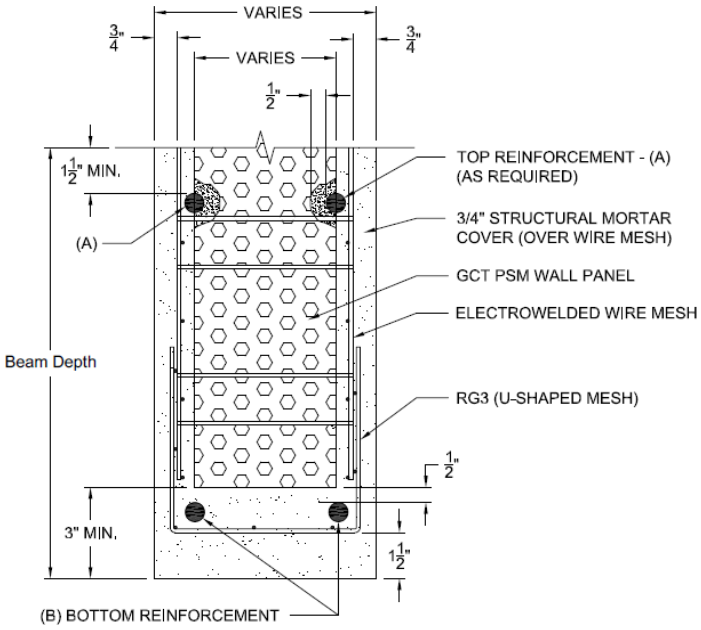
Table 9b: Factored Uniform Load Capacity of GCT Beams



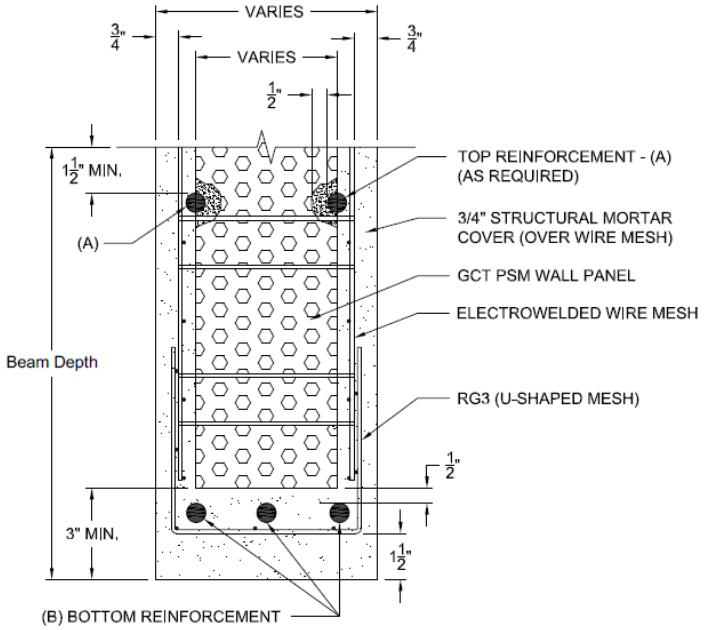
Detail 1



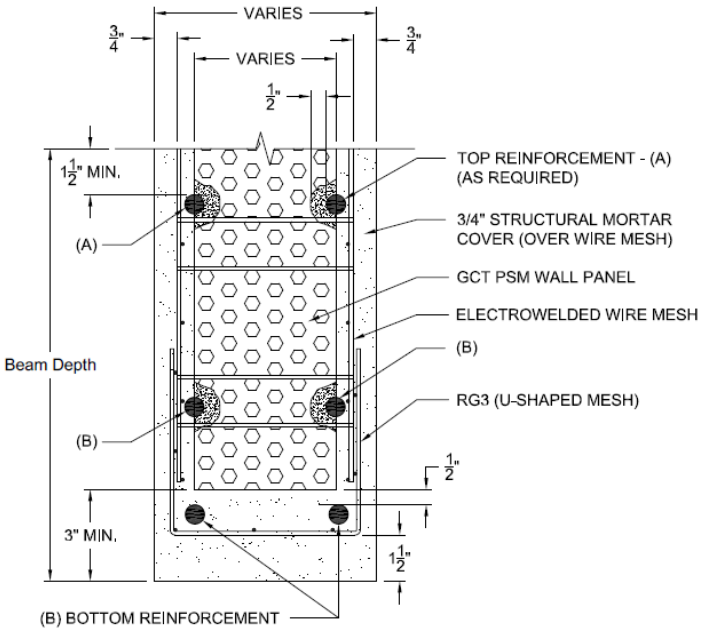
Detail 2



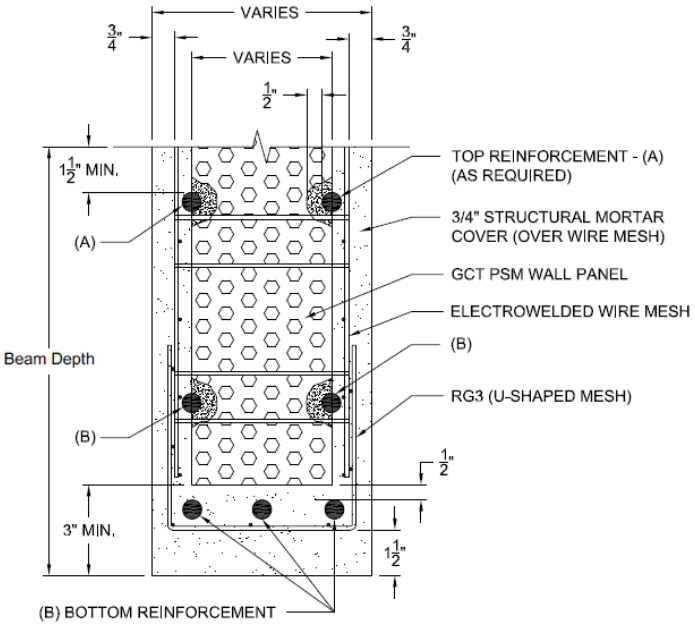
Detail 3



Detail 4



Detail 5



Detail 6

5.6. Shear Walls

5.6.1. The factored racking shear (i.e., for lateral shear wall design) load on GCT panel walls is limited to the capacities shown in Table 10.

Factored Racking Shear Capacity for GCT Insulated Concrete Panels				
GCT Panel Type	Wall Length (ft.)	Wall Height (ft.)[1]		
		8'	9'	10'
		Racking Shear (plf)		
PSM	1.0'	455	405	360
	1.5'	610	545	490
	2.0'	775	685	620
	2.5'	935	830	745
	3.0'	1,095	975	875
	4' or greater	1,420	1,260	1,135
PSM HP	1.0'	910	810	725
	1.5'	1,225	1,090	980
	2.0'	1,550	1,375	1,240
	2.5'	1,870	1,665	1,495
	3.0'	2,195	1,950	1,755
	4' or greater	2,840	2,525	2,270
1. Interpolation between wall heights is permitted.				

Table 10: Factored Racking Shear Capacities for GCT Panels

5.7. GCT insulated concrete panels have the design interaction diagrams for out-of-plane bending shown in Figure 8 and Figure 9.

5.7.1. The interaction diagrams shown in Figure 8 and Figure 9 are for 1' of panel width and account for failure of the panels by concrete crushing. See Table 5 for the maximum axial load capacities of GCT wall panels that include limits due to buckling.

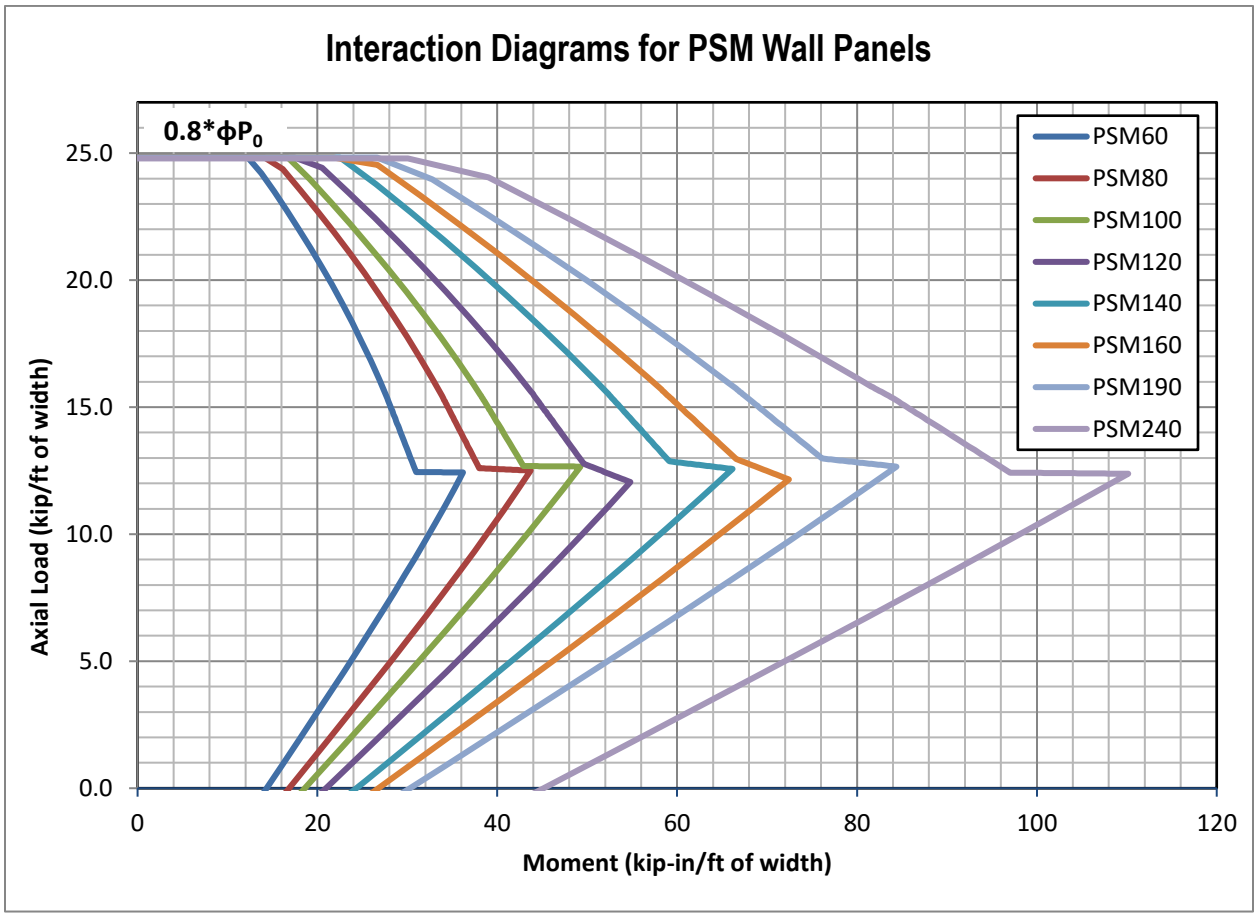


Figure 8: Interaction Diagram for PSM Panels

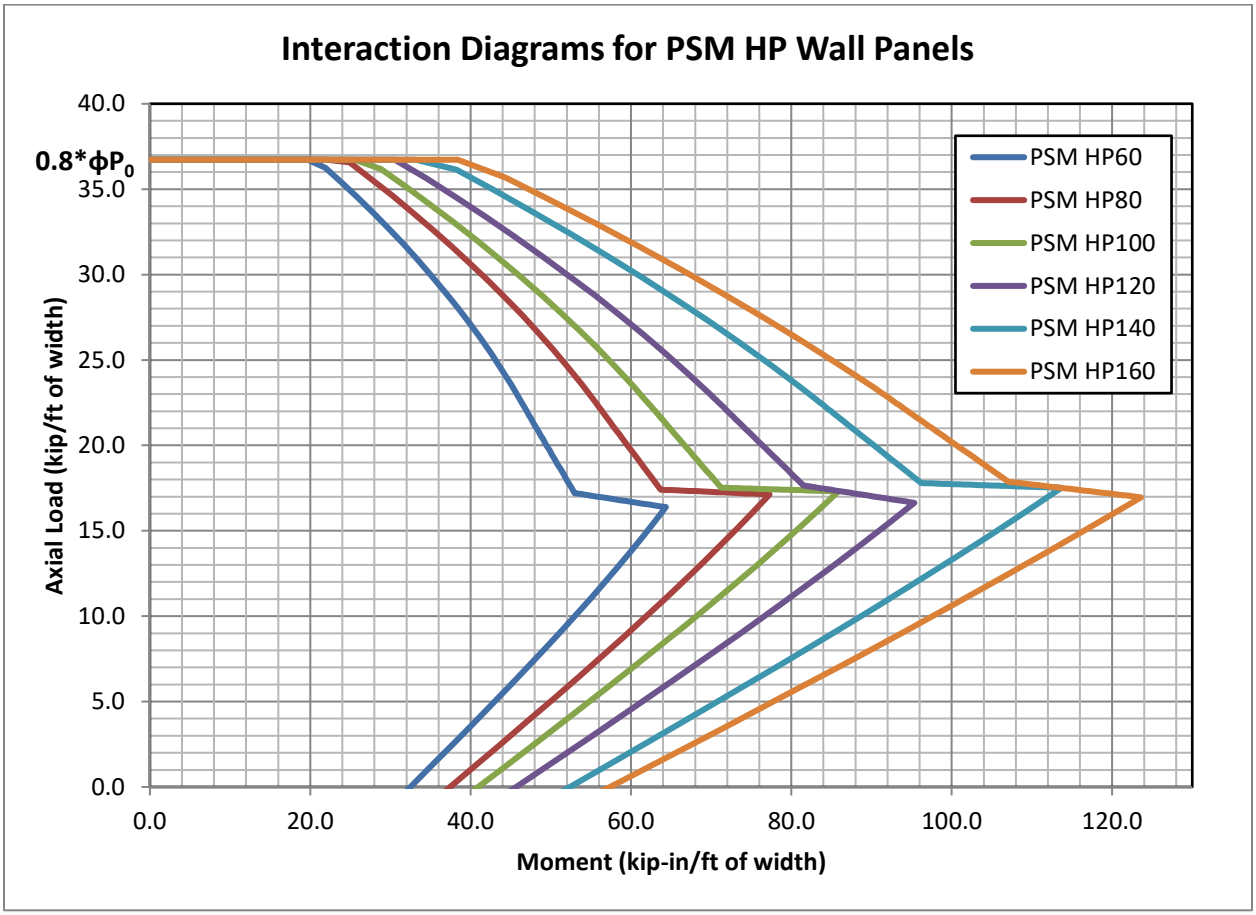


Figure 9: Interaction Diagram for PSM HP Panels

5.8. R-values and U-factors assigned to GCT panels

GCT Panel Type	R-Value	U-factor	GCT Panel Type	R-Value	U-factor	GCT Panel Type	R-Value	U-factor	GCT Panel Type	R-Value	U-factor
PSM, PSM HP, or PSM-Slab	°F × h × ft.²/Btu	Btu/°F × h × ft.²	PSG	°F × h × ft.²/Btu	Btu/°F × h × ft.²	PSG	°F × h × ft.²/Btu	Btu/°F × h × ft.²	PSG	°F × h × ft.²/Btu	Btu/°F × h × ft.²
60	9	0.10	PSG2 100	20	0.05	PSG3 200	29	0.03	PSG6 100R	33	0.03
80	12	0.08	PSG2 140	24	0.04	PSG3 240	34	0.03	PSG6 140R	30	0.03
100	14	0.07	PSG2 160	27	0.04	PSG6 100	15	0.07	PSG6 160R	29	0.03
120	17	0.06	PSG2 200	31	0.03	PSG6 140	18	0.06	PSG6 200R	26	0.04
140	20	0.05	PSG2 240	36	0.03	PSG6 160	19	0.05			
160	23	0.04	PSG3 100	18	0.05	PSG6 180	21	0.05	–	–	–
190	27	0.04	PSG3 140	23	0.04	PSG6 200	22	0.05	–	–	–
240	34	0.03	PSG3 160	25	0.04	PSG6 240	25	0.04	–	–	–

1. Table values are calculated based on the sum of the R-values of the component parts of the GCT panels and include analysis of the conductance of the ties running through the EPS core.
2. The R-values are calculated based on *ASHRAE 90.1*.

Table 11: GCT Panel R-Values & U-factors[1, 2]

5.9. Impact Testing

5.9.1. GCT PSM and PSM HP panels were tested in accordance with *TAS 201 – Impact Test Procedures* and meet the missile impact test criteria for wind-borne debris in High Velocity Hurricane Zones (HVHZ) in accordance with *FBC* Section 1626.

5.9.1.1. The PSM panels resisted the impact of the 9-lb. 2x4 missile propelled at 50 ft./s (34 mph) without any noteworthy damage to the backside of the panel.

5.9.1.2. The PSM HP panels resisted the impact of a 15-lb. 2x4 missile propelled at 100 ft./s (67 mph) without any noteworthy damage to the backside of the panel.

5.9.2. Testing in accordance with *TAS 203 – Criteria for Testing Products Subject to Cyclic Wind Pressure Loading* is outside the scope of this TER.

5.9.3. GCT PSM, PSM HP, and PSG panels are deemed to comply with the impact test requirements for installation in HVHZ in accordance with *FBC* Section 1626 when a minimum concrete cover of 2" is applied to the exterior side of the panel.

5.9.3.1. *FBC* Section 1626.4 states that the following construction assembly is deemed to comply:

> Exterior reinforced concrete elements constructed of solid normal weight concrete (no voids), designed in accordance with Chapter 19 (High-Velocity Hurricane Zones) of this code and having a minimum 2-in. (51 mm) thickness.

5.10. Storm Shelters

5.10.1. GCT PSM HP panels were tested according to the procedures in *ICC 500* Section 804 and meet the missile impact test criteria for use as horizontal or vertical shelter envelop surfaces in accordance with *ICC 500* Section 305.

5.10.1.1. The PSM HP panels resisted the impact of a 15-lb. 2x4 missile propelled at 67 mph and 100 mph without any noteworthy damage to the backside of the panel.

5.10.2. GCT PSM HP panels meet the missile impact test criteria for tornado shelters with a design wind speed of 250 mph or less in accordance with *ICC 500* Section 305.1.1. This exceeds the estimated wind speed for an EF5 tornado.

5.10.2.1. Design wind speeds for tornados shall be determined in accordance with *ICC 500* Figure 304.2(1).

5.10.3. GCT PSM HP panels meet the missile impact test criteria for hurricane shelters with a design wind speed of 250 mph or less in accordance with *ICC 500* Section 305.1.2. This exceeds the sustained wind speed for a category 5 hurricane.

5.10.3.1. Design wind speeds for hurricanes shall be determined in accordance with *ICC 500* Figure 304.2(2).

Photo 2: PSM Panel Tested in Accordance with TAS 201-94

5.11. Ballistics

5.11.1. GCT PSM panels were tested in accordance with *ANSI/UL 752-05 – Standard for Bullet-Resisting Equipment* (modified) for non-metallic, protection Level 3.

5.11.1.1. Level 3 provides protection from 240 grain, .44 Magnum rounds without any penetration or spalling on the backside of the panel

5.11.2. GCT PSM panels satisfied the ballistic resistance requirements of National Institute of Justice (NIJ) Standard-0108.01, Level III-A.

5.11.2.1. Level III-A protection can resist .44 Magnum and Submachine Gun 9 mm rounds and provides protection against most types of handguns.

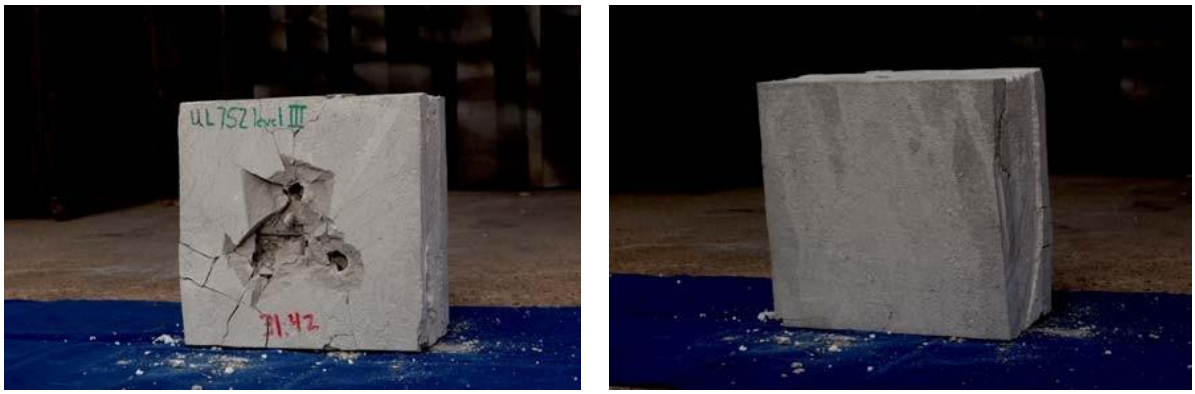


Photo 3: Front & Back of Panel from Ballistics Test

5.12. Foundation Walls

5.12.1. GCT panels may be used to construct foundation walls in accordance *IRC* Chapter 4 or *IBC* Chapter 16, 18 and 19.

5.12.2. When used in foundation application, GCT panels shall be installed in accordance with this TER as well as TER No. 1202-12.f.

5.12.3. Exposed Basement

5.12.3.1. GCT foundation panels may be used in above-grade stem wall applications subject to transverse wind loads in accordance with *IRC* Section 301 and *IBC* Section 1609, provided the applied loads do not exceed the flexural strength as shown in Table 3 and Table 4.

5.13. Seismic Design

5.13.1. Structures shall be designed for seismic forces in accordance with *IBC* Section 1613.

5.13.1.1. Seismic design for GCT floor, wall and roof insulated concrete panels shall not be required in buildings exempt from seismic design in accordance with *IBC* Section 1613.

5.13.2. Table 12 provides seismic design coefficients (SDC) that conform to the requirements in *ASCE 7-10* Section 12.2.1 and Table 12.2-1 for design of shear walls in buildings that require seismic design in accordance with *ASCE 7* (i.e., all seismic design categories).

5.13.2.1. The response modification coefficient, R, system overstrength factor, Ω_0, and deflection amplification factor, C_d, indicated in Table 12 shall be used to determine the base shear, element design forces, and design story drift in accordance with *ASCE 7* Chapter 12 and Section 14.5.

5.13.3. GCT wall panels used to resist shear forces shall have the following reinforcement provided:

5.13.3.1. GCT wall panels shall be anchored to the foundation/floor slab with a minimum of 18" long #4 rebar placed 12" o.c., staggered, on each side of the panel, except on the edges that need to be placed side-by-side. The rebar shall be provided with ¾" cover on all sides and shall be placed inside of the wire mesh reinforcement.

5.13.3.2. GCT wall panels shall have angled wire mesh connecting the wall panels to the roof/floor panels. The wire mesh shall be embedded a minimum of 8" into the structural mortar cover of each panel and shall be provided on both the top and bottom of the roof/floor panel.

5.13.3.3. The edges of all GCT wall panels shall be provided with U-shaped wire mesh with 6" legs and a minimum of 3" of structural mortar cover.

5.13.3.4. Where adjoining pieces of angled or U-shaped wire mesh reinforcement are spliced, the pieces shall overlap by a minimum of two wire spaces.

5.13.3.5. A 1' x 2' piece of wire mesh installed at a 45° angle shall be provided at the corners of all openings on both sides of the GCT wall panels.

Seismic Design Coefficients for GCT PSM & PSM HP Shear Walls									
Seismic Force-Resisting System	GCT Panel Type	Response Modification Factor, R[1]	System Overstrength Factor, Ω_0[2]	Deflection Amplification Coefficient, C_d[3]	Structural System Limitations & Building Height (ft.) Limit[4]				
					Seismic Design Category				
					B	C	D	E	F
Special Reinforced Concrete Shear Walls	PSM	5	2.5	5	NL	NL	160	160	100
	PSM HP	5	2.5	5	NL	NL	160	160	100

1. Response modification coefficient, R, for use throughout *ASCE 7*. Note: R reduces forces to a strength level, not an allowable stress level.
2. The tabulated value of the overstrength factor, Ω_0, is permitted to be reduced by subtracting one-half (0.5) for structures with flexible diaphragms.
3. Deflection amplification factor, C_d, for use with *ASCE 7* Section 12.8.6, 12.8.7, and 12.9.2.
4. NL = Not Limited. Heights are measured from the base of the structure as defined in *ASCE 7* Section 11.2.

Table 12: Seismic Performance of GCT Wall Panels

5.14. Dampproofing and Waterproofing

5.14.1. Dampproofing shall be implemented as required by *IRC* Section R406.1 or *IBC* Section 1805.2.

5.14.2. Waterproofing shall be implemented as required by *IRC* Section R406.2 or *IBC* Section 1805.3.

5.15. Foam Plastic Insulation

5.15.1. The EPS core that is integral to the GCT panels shall meet the requirements of *IBC* Section 2603 and *IRC* Section R316.4 as appropriate for this application.

5.15.2. Thermal Barrier

5.15.2.1. An independent thermal barrier in accordance with *IRC* Section R316.4 or *IBC* Section 2603.4 is not required because the EPS core is covered, in all cases, by mortar, and never exposed to the interior of the building.

5.15.3. The EPS core has been tested in accordance with *ASTM D1929* and has a self-ignition temperature of 914°F (490°C).

5.15.3.1. The EPS core is an approved foam plastic for use in HBHZ in accordance with *FBC* Section 2612.2.

5.15.4. Fire Endurance Performance

5.15.4.1. See TER No. 1201-04 for the required mortar thickness for applications where fire-resistance ratings are required.

5.15.4.2. For applications on buildings of any height, fire blocking must be installed in accordance with the applicable code. This includes fire blocking, as appropriate, at floor-to-wall intersections to prevent the passage of flame, smoke and hot gasses from one story to another.

5.15.4.3. The EPS core must not be continuous from one story to another.

6. Installation:

6.1. GCT panels shall be installed in accordance with the construction documents, the installation instructions provided with the shipment of panels and this TER. In the event of conflict, the more restrictive shall govern.

6.2. Installation, support and structural detailing required for connections will be provided by GCT for each project, to assure a proper load path to the foundation.

6.2.1. Example details can be found in Appendix A.

6.2.2. Details shall be evaluated by the building designer for applicability to a specific building.

6.2.3. Installation shall be performed in accordance with the manufacturer's installation instructions.

6.3. Support for GCT panels (e.g., foundation walls, footings, etc.) must be level and free of dirt and loose material.

6.4. GCT panels shall be installed and aligned in accordance with the plans designed and submitted to the building official per Section 9.

6.5. The high-strength mortar complying with Section 4.11.4 is applied to each face of the GCT wall panels and the underside of floor assemblies covering the welded wire mesh.

6.5.1. Mortar thickness is per the approved plans with a minimum cover of 1" (3/4" + 1/4") over the wire mesh.

6.5.2. The tolerance is -1/4".

6.6. The high-strength mortar shall be applied using a low-velocity application process, in accordance with the manufacturer's installation instructions and this TER.

6.7. Where required, special inspection of the mortar application shall be in accordance with *IBC* Section 1910.10[4] and Table 1705.3.

6.8. Where required, continuous inspection of poured concrete shall be in accordance with *IBC* Section 1705.3.

7. Test and Engineering Substantiating Data:

7.1. Test reports and data for axial and transverse loading in accordance with *ASTM E72* conducted by an ISO/IEC 17025 accredited testing laboratory under contract with Qualtim, Inc.

7.2. *Investigation of Wind Projectile Resistance of Emmedue M2 Panels*; The Wind Science and Engineering Research Center, Texas Tech University; February 11, 2005.

7.3. *Investigation of Wind Projectile Resistance of Emmedue M2 Panels*; The Wind Science and Engineering Research Center, Texas Tech University; July 22, 2005.

7.4. The product(s) evaluated by this TER falls within the scope of one or more of the model, state or local building codes for building construction. The testing and/or substantiating data used in this TER is limited to buildings, structures, building elements, construction materials and civil engineering related specifically to buildings.

7.5. The provisions of model, state or local building codes for building construction do not intend to prevent the installation of any material or to prohibit any design or method of construction. Alternatives shall use consensus standards, performance-based design methods or other engineered alternative means of compliance. This TER assesses compliance with defined standards, generally accepted engineering analysis, performance-based design methods, etc. in the context of the pertinent building code requirements.

7.6. Some information contained herein is the result of testing and/or data analysis by other sources, which DrJ relies on to be accurate as it undertakes its engineering analysis.

7.7. DrJ has reviewed and found the data provided by other professional sources credible. This information has been approved in accordance with DrJ's procedure for acceptance of data from approved sources.

7.8. DrJ's responsibility for data provided by approved sources is in accordance with professional engineering law.

7.9. Where appropriate, DrJ relies on the derivation of design values, which have been codified into law through codes and standards (e.g., *IRC*, *WFCM*, *IBC*, *SDPWS*, etc.). This includes review of code provisions and any related test data that helps with comparative analysis or provides support for equivalency to an intended end-use application.

8. Findings:

8.1. GCT insulated concrete panels as described in this TER comply with, or are suitable alternatives to, the applicable sections of the *IBC, IRC and IECC*, and are subject to the conditions listed in Section 9.

8.2. *IBC* Section 104.11 and *IRC* Section R104.11 (*IFC* Section 104.9 is similar) state:

[4] *2015 IBC* Section 1908.10

> **104.11 Alternative materials, design and methods of construction and equipment.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the *building official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code. … Where the alternative material, design or method of construction is not *approved*, the *building official* shall respond in writing, stating the reasons the alternative was not *approved*.[5]

8.3. This product has been evaluated with the codes listed in Section 2, and is compliant with all known state and local building codes. Where there are known variations in state or local codes that are applicable to this evaluation, they are listed here:

8.3.1. No known variations

8.4. This TER uses professional engineering law, the building code, ANSI/ASTM consensus standards and generally accepted engineering practice as its criteria for all testing and engineering analysis. DrJ's professional engineering work falls under the jurisdiction of each state Board of Professional Engineers, when signed and sealed.

9. Conditions of Use:

9.1. Where required by the authority having jurisdiction (AHJ) in which the project is to be constructed, this report and the installation instructions shall be submitted at the time of permit application.

9.2. Any generally accepted engineering calculations needed to show compliance with this TER shall be submitted to the code official for review and approval.

9.3. Design loads shall be determined in accordance with the building code adopted by the jurisdiction in which the project is to be constructed.

9.4. GCT insulated concrete panels, as described in this TER, are subject to the following conditions:

9.4.1. This TER, when required by the authority having jurisdiction, shall be submitted at the time of permit application.

9.4.2. Design drawings and calculations shall follow the requirements of this TER and be submitted to the building official for approval.

9.4.3. Where required by the statutes of the jurisdiction where the building is to be constructed, the design drawings shall be prepared by the Registered Design Professional (RDP) for the Building licensed in the jurisdiction.

9.4.4. When required by the applicable code, an underground water investigation shall be made. If a hydrostatic pressure condition exists, the foundation walls must be waterproofed in accordance with the code.

9.4.4.1. Evaluation of waterproofing materials is outside the scope of this TER.

9.4.5. The soil capacity of the building site must be consistent with the requirements of the applicable code.

9.4.5.1. For use with the *IRC*, the soil capacity of the site may be assumed to have the load-bearing capacities specified in *IRC* Table R401.4.1.

9.4.5.2. In this case, a separate geotechnical evaluation is not required.

9.4.6. The installation shall comply with this TER, the manufacturer's installation instructions and the applicable code.

9.4.7. Installation of the high-strength mortar and concrete, which require special inspection under the *IBC*, shall comply with Section 6.5 and 6.6.

9.5. GCT foundation panels must be designed, manufactured, identified and installed in accordance with this TER.

9.5.1. Each installation shall provide GCT quality control specimens for testing to confirm fundamental design properties of the mortar and the panels.

[5] The last sentence is adopted language in the 2015 codes.

9.5.2. Each installation shall provide verification that the GCT panels were installed in accordance with the GCT installation instructions and connection details.

9.6. Design

9.6.1. Building Designer Responsibility

9.6.1.1. Unless the AHJ allows otherwise, the Construction Documents shall be prepared by a Building Designer (e.g., Owner, Registered Design Professional, etc.) for the Building and shall be in accordance with *IRC* Section R106 and *IBC* Section 107.

9.6.1.2. The Construction Documents shall be accurate and reliable and shall provide the location, direction and magnitude of all applied loads and shall be in accordance with *IRC* Section R301 and *IBC* Section 1603.

9.6.2. Construction Documents

9.6.2.1. Construction Documents shall be submitted to the Building Official for approval and shall contain the plans, specifications and details needed for the Building Official to approve such documents.

9.7. Responsibilities

9.7.1. The information contained herein is a product, engineering or building code compliance research report performed in accordance with the referenced building codes, testing and/or analysis through the use of accepted engineering procedures, experience and technical judgment.

9.7.2. DrJ research reports provide an assessment of only those attributes specifically addressed in the Products Evaluated or Code Compliance Process Evaluated section.

9.7.3. The engineering evaluation was performed on the dates provided in this TER, within DrJ's professional scope of work.

9.7.4. This product is manufactured under a third-party quality control program in accordance with *IRC* Section R104.4 and R109.2 and *IBC* Section 104.4 and 110.4.

9.7.5. The actual design, suitability and use of this research report for any particular building is the responsibility of the Owner or the Owner's authorized agent, and the report shall be reviewed for code compliance by the Building Official.

9.7.6. The use of this TER is dependent on the manufacturer's in-plant QC, the ISO/IEC 17020 third-party inspection process, proper installation per the manufacturer's instructions, the Building Official's inspection and any other code requirements that may apply to assure accurate compliance with the applicable building code.

10. Identification:

10.1. PSP, PSM, PSM HP, and PSG Series panels described in this TER are identified by labels that show Gulf Concrete Technology, 4739 West Oreck Road, Long Beach, MS 39560, the product numbers that are given in this report, and the name of the quality control inspection agency.

10.2. Additional technical information can be found at www.gctm2.com.

11. Review Schedule:

11.1. This TER is subject to periodic review and revision. For the most recent version of this report, visit drjengineering.org.

11.2. For information on the current status of this report, contact DrJ Engineering.

- Mission and Professional Responsibilities
- Product Evaluation Policies
- Product Approval – Building Code, Administrative Law and P.E. Law

Appendix A:
Miscellaneous Floor Slab, Foundation Wall, Floor, Wall and Roof Construction Details

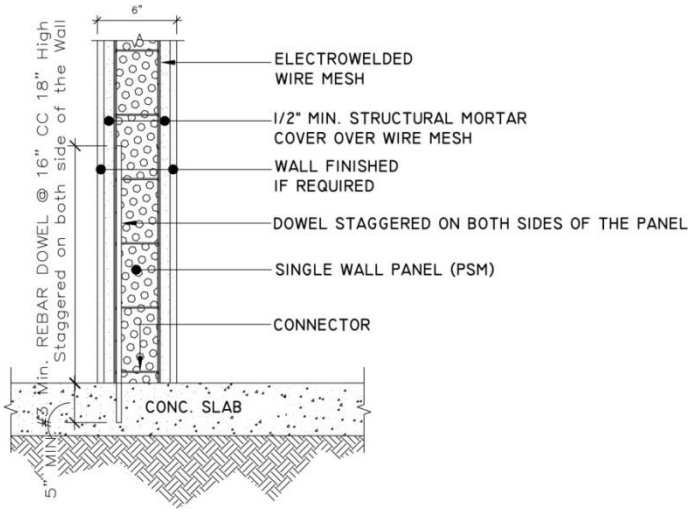


Figure 10: Example of GCT Panel Connection to Interior Slab on Grade Slab Footing

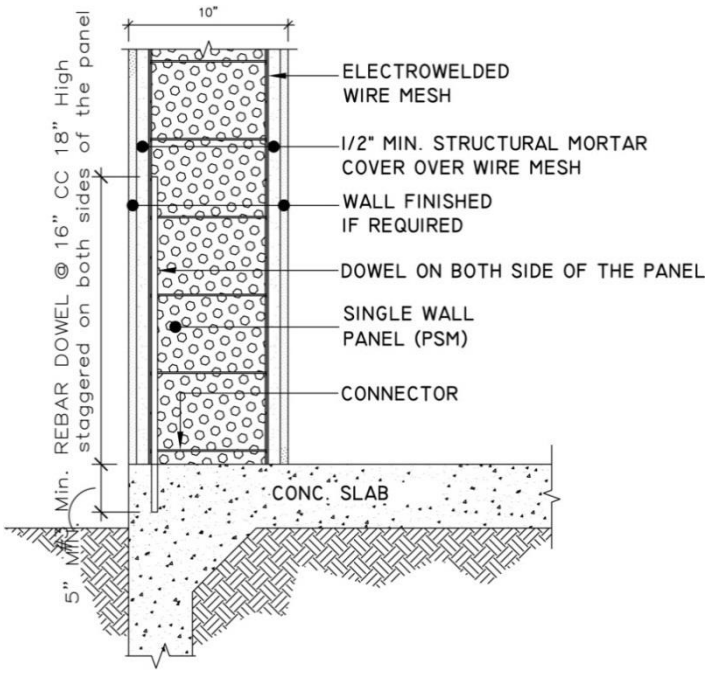
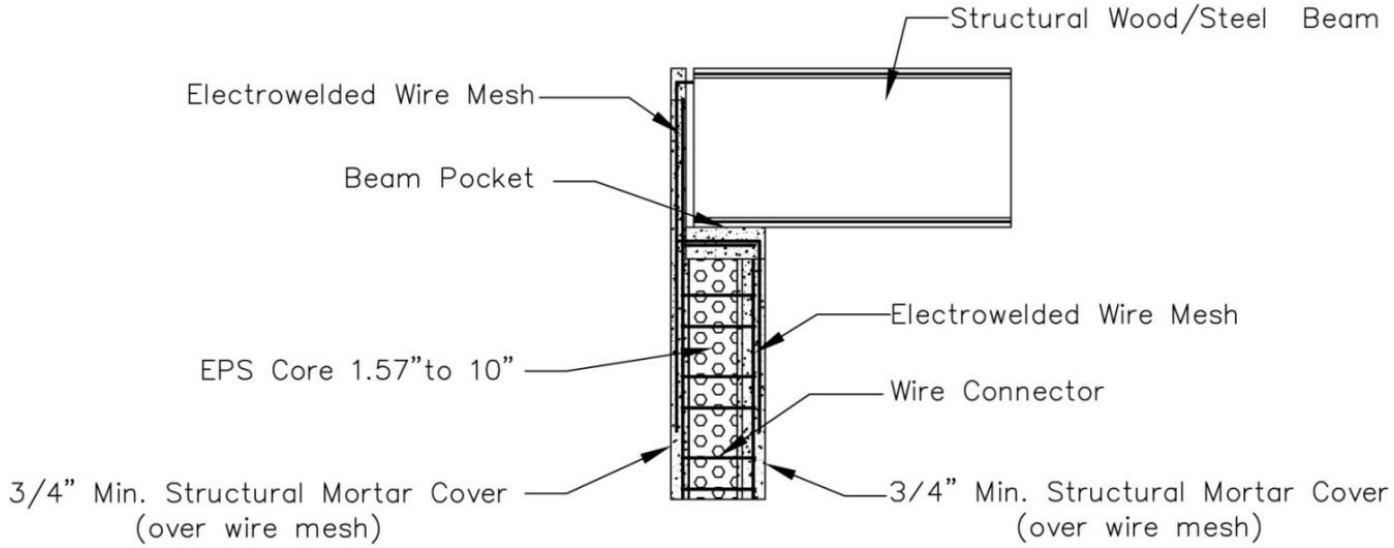


Figure 11: Example of GCT Panel Connection at Exterior Turned Down

Figure 12: PSM Wall Section with Beam Pocket



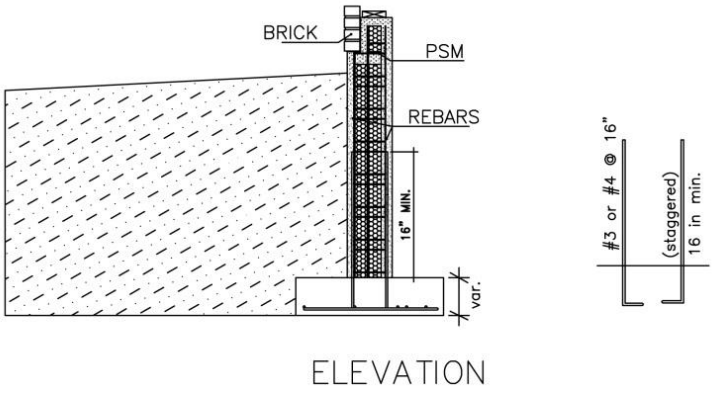


Figure 13: Foundation Anchoring to PSM Wall

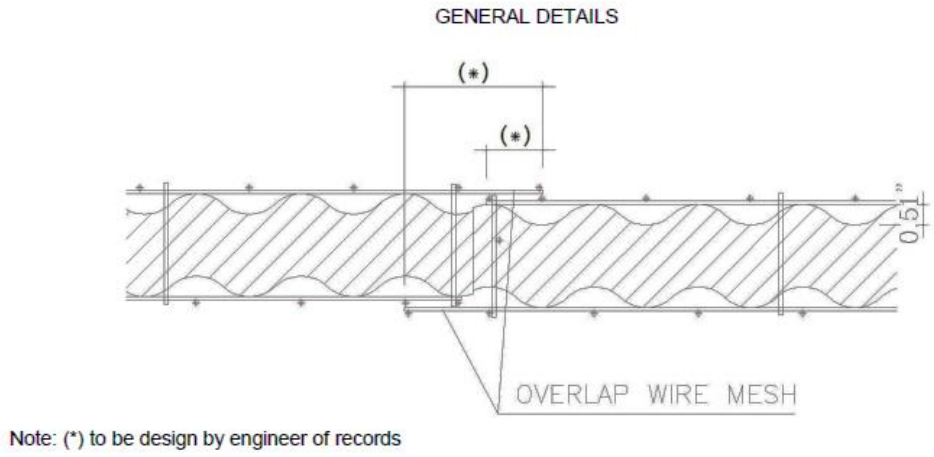


Figure 14: Panel to Panel Connection/Joint

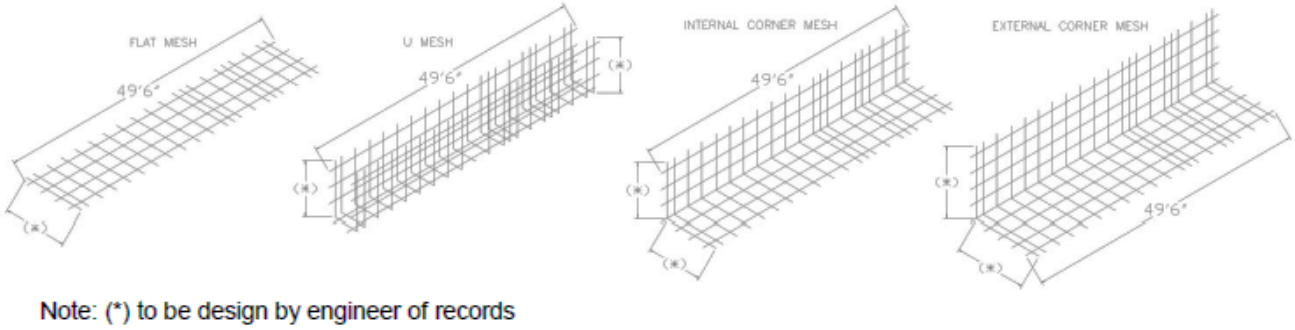


Figure 15: Panel to Panel Connection/Joint

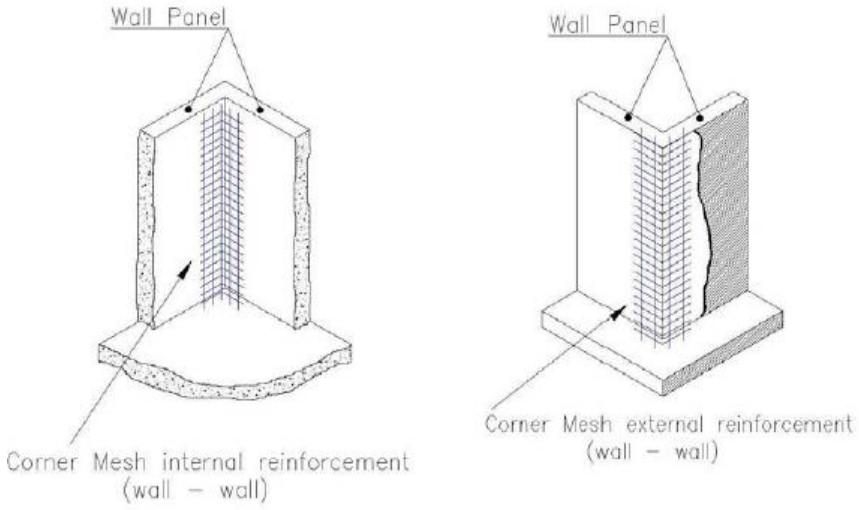
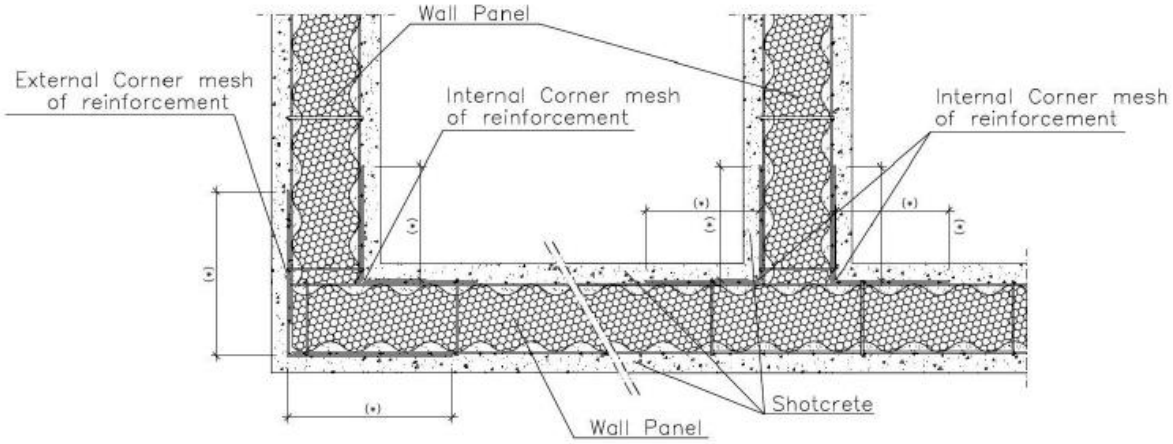


Figure 16: Typical Types of Mesh Used for Reinforcement/Connection



Note: (*) to be designed by engineer of records

Figure 17: Internal Corner Mesh Reinforcement

EXTERIOR WALL PANEL TO FLOOR/ROOF PANEL CONNECTION

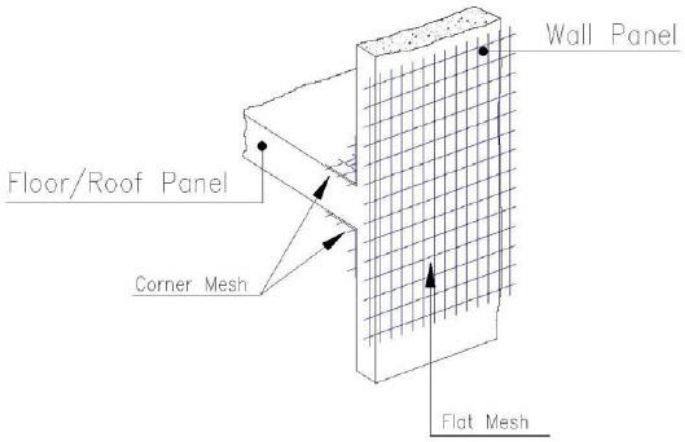


Figure 18: Exterior Panel to Floor/Roof Panel Connection

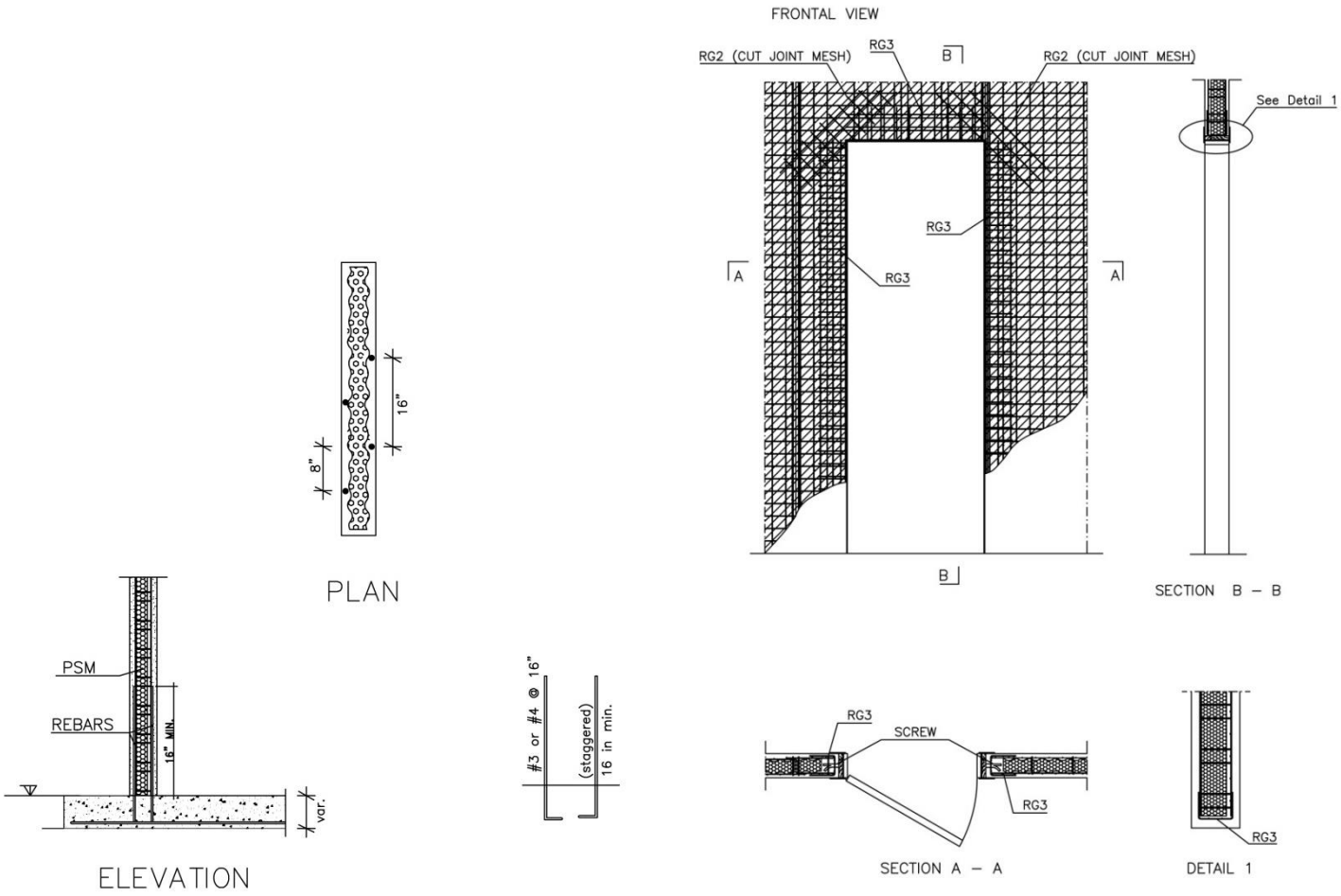


Figure 20: Opening Reinforcement for a PSM Wall

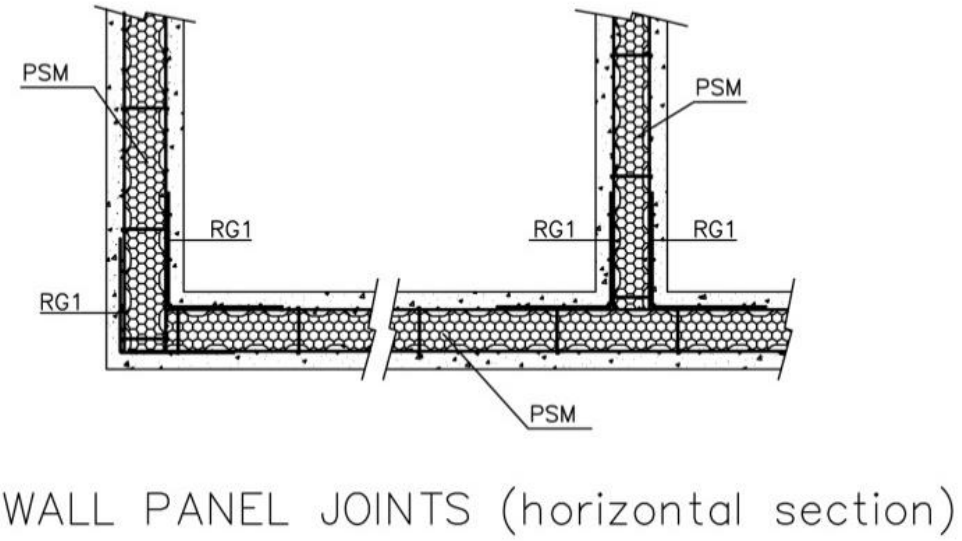


Figure 21: Wall Single PSM Panel Connection

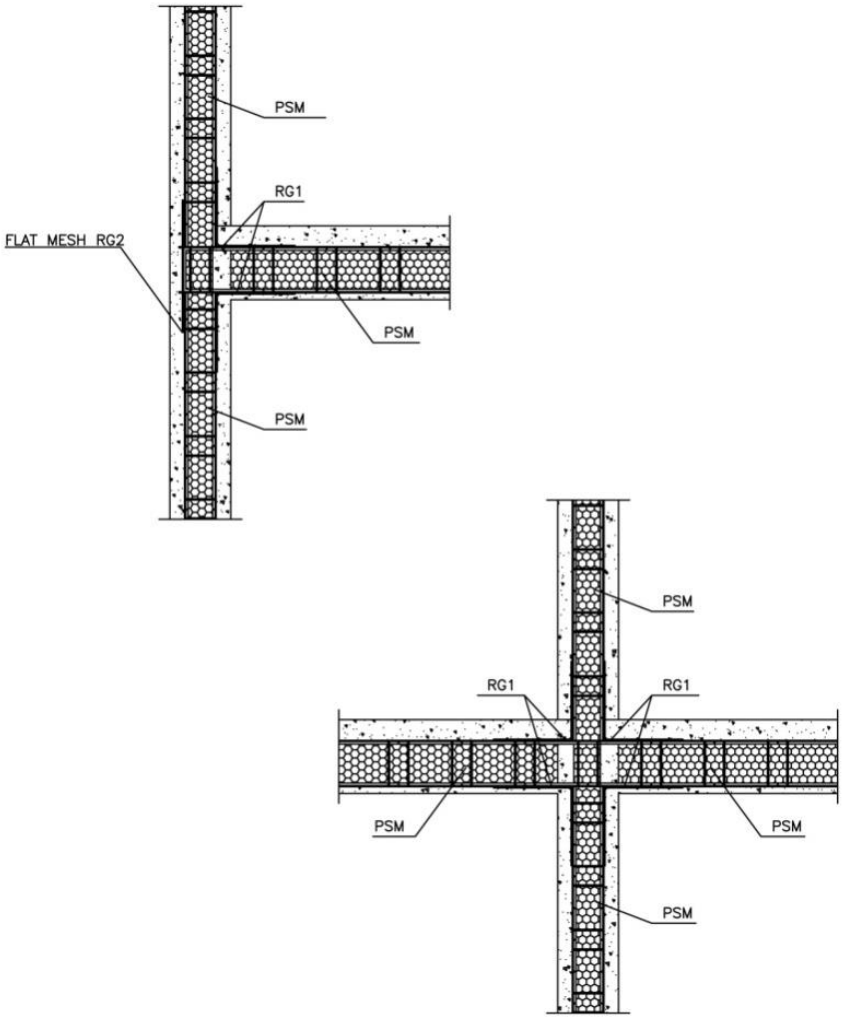
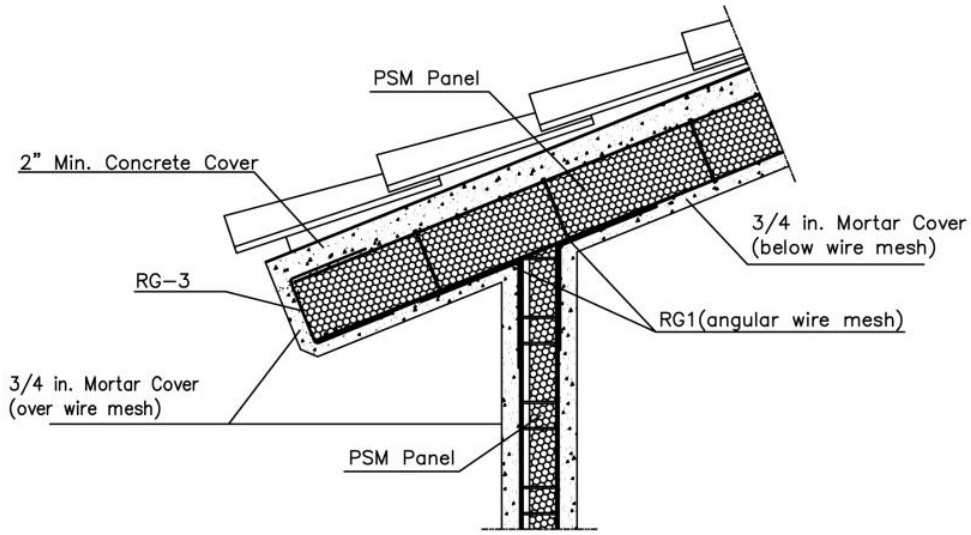
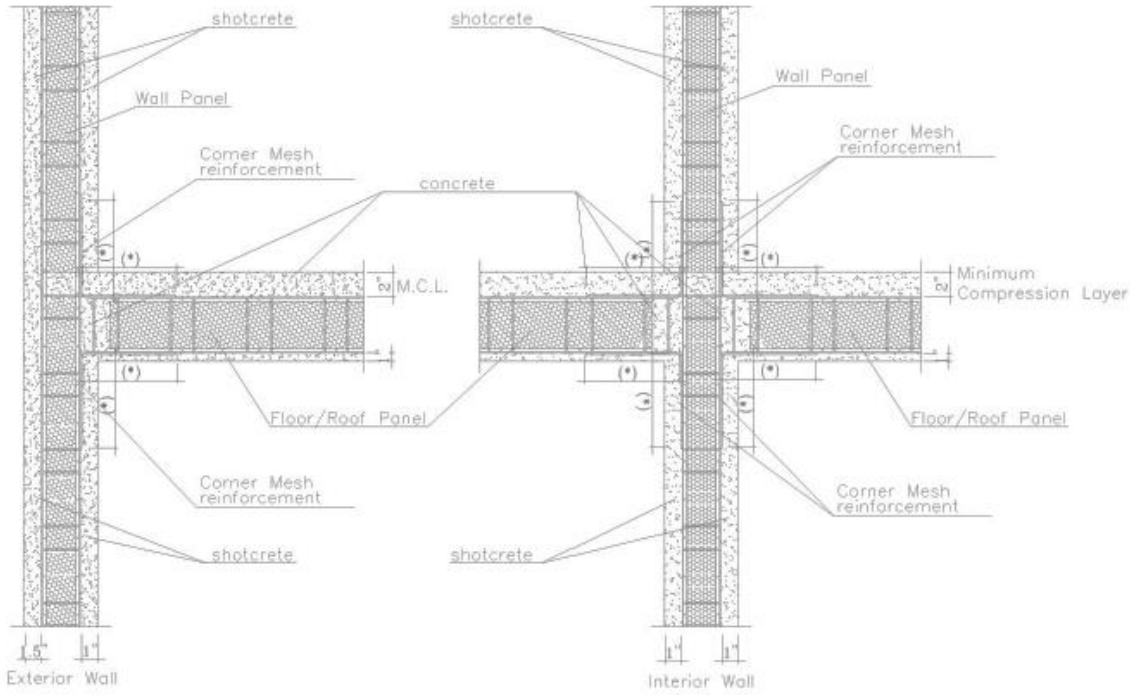


Figure 22: PSM-Slab to PSM Wall Connection

Figure 23: PSM Wall to PSM Roof Connection





Note: (*) to be designed by engineer of records

Figure 24: Wall Panel to Floor/Roof Panel Connection

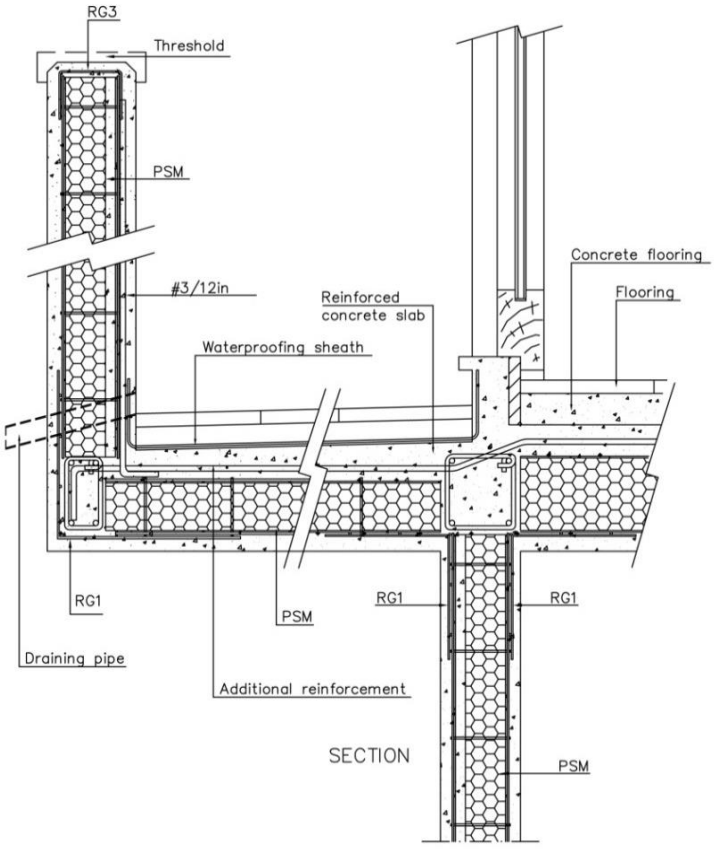


Figure 25: Balcony Structural Details with PSM Wall

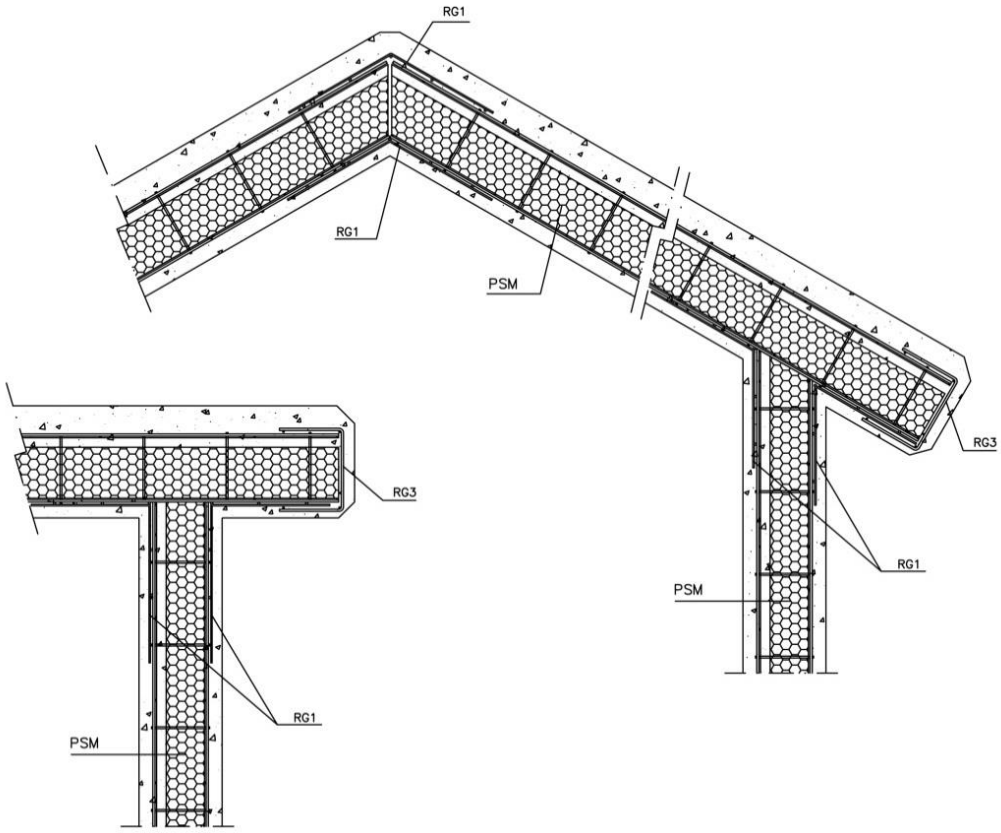
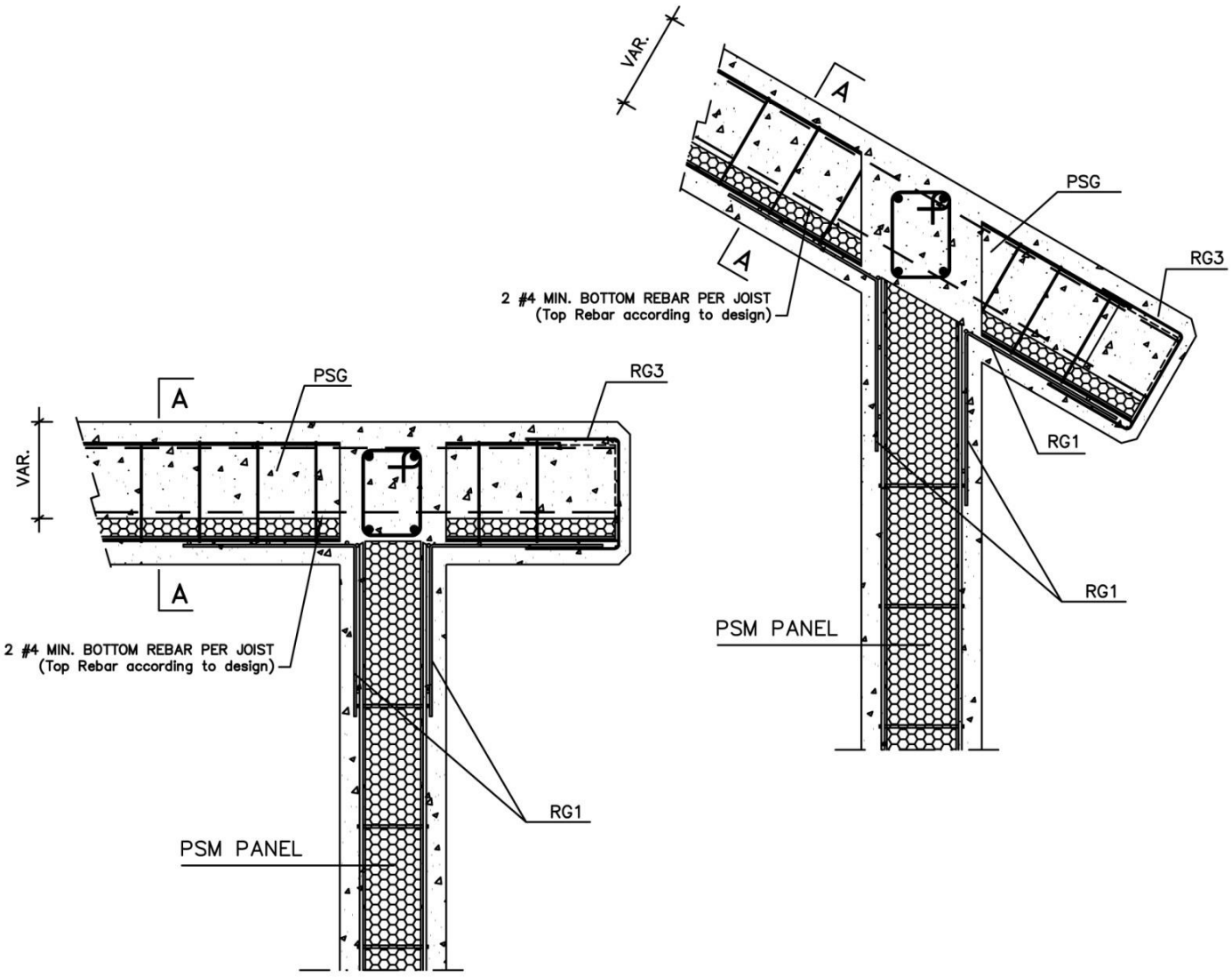
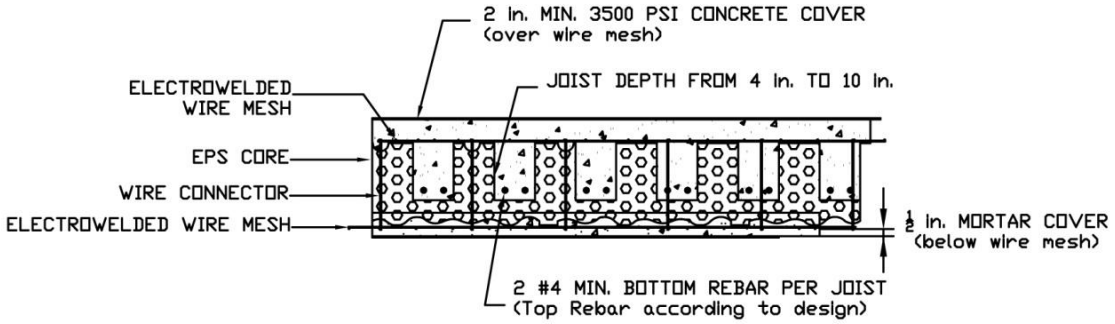


Figure 26: PSM Roof Connection to PSM Wall

Figure 27: PSM Roof Connection to PSM Wall





SECTION A–A